THE GAS JOURNAL

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A Glance at the Contents—

Birmingham Gas Order.

This Order was the subject of an inquiry by Mr. F. J. Ronca at the Board of Trade Offices last Friday. The Birmingham Corporation are applying for an extension of their limits of gas supply. [p. 211.]

Efficiency of Gas Manufacture.

A table comparing the working results of four types of carbonizing plant is given. This table, which is due to Mr. F. M. Birks, of the Gas Light and Coke Company, should prove a valuable reference. [p. 196.]

Annual Meeting of Gas Salesmen.

There was a representative attendance of members from all parts of the country at the Annual Meeting of Gas Salesmen organized by the British Commercial Gas Association at the Caxton Hall, Westminster, Mr. William Cash presiding. [p. 201.]

Economics of Gas Traction.

The development of the use of compressed gas for motor transport was discussed from many angles at an informal meeting of the Institute of Fuel last Friday, the subject being introduced by Dr. C. M. Walter, of the Birmingham Gas Department. [p. 200.]

Coal Utilization Council.

In a paper before the Royal Society of Arts last Wednesday, Mr. W. R. Gordon, Director of the Coal Utilization Council, explained the plans of the Council for sales education and sales training. [p. 198.]

Steam Requirements on a Gas-Works.

Steam Requiremnts on a Gas-Works was the subject of a paper given by Mr. F. M. Birks, O.B.E., M.I.Mech.E., before the Institution of Mechanical Engineers on April 20. [p. 210.]

Carbonizing Results in Vertical Practice.

Mr. F. H. Bate and Mr. A. R. Myhill recounted some recent experiences at Birmingham in regard to factors influencing carbonizing results in vertical retort practice in a paper before the Midland Junior Gas Association. [p. 203.]

The Gum Problem.

A contribution by Mr. W. H. Fulweiler shows what developments have taken place in providing a solution to the whole gum problem. In the author's words, "The advance made during the past year encourages us to hope that, at the present rate of progress, another year's work will furnish solutions for all the more important features of the gum problem." [p. 207.]

Forthcoming Engagements

April 26.—SOUTHERN ASSOCIATION (EASTERN DISTRICT).—Meeting at 28, Grosvenor Gardens, S.W. 1, 2.30 p.m.

April 30.—I.G.E.—Meeting of Liquor Effluents and Ammonia Sub-Committee, 2.30 p.m.

May 1.—I.G.E.—Meetings of Joint Research Committee, 10.30 a.m.; General Research Committee, 2.30 p.m.

May 3.—MIDLAND JUNIOR ASSOCIATION.—Annual Meeting. Address by Mr. R. S. Ramsden.

May 4.—LONDON AND SOUTHERN JUNIOR ASSOCIATION.—Annual Business Meeting.

May 4.—NORTH OF ENGLAND ASSOCIATION.—Annual Meeting at the County Hotel, Newcastle-upon-Tyne, 2 p.m.

May 8.—N.G.C.—Annual General Meeting, Hotel Metropole, W.C. 2, 2.30 p.m.

May 9.—MANCHESTER AND DISTRICT JUNIOR ASSOCIATION.—Visit to Mossley. Paper by Mr. T. Hibbs.

May 9.—S.B.G.I.—Annual General Meeting and Dinner, Hotel Metropole, London.

May 9.—INSTITUTE OF FUEL.—Meeting at Burlington House, W. 1, 6 p.m. Paper by Major M. Koopman on "The Distribution and Utilization of Coke Oven Gas in the Heavy Industries."

May 10.—SOUTHERN ASSOCIATION.—Western District Commercial Meeting at Exeter, 2.30 p.m.

May 10 & 11.—EASTERN COUNTIES GAS MANAGERS' ASSOCIATION.—Spring Meeting at Cleethorpes.

May 12.—SCOTTISH EASTERN JUNIOR ASSOCIATION.—Annual General Meeting and Paperette Day in Heriot Watt College, Edinburgh.

May 17.—MIDLAND ASSOCIATION.—Spring General Meeting at Leamington.

May 17.—WALES AND MONMOUTHSHIRE ASSOCIATION.—General Meeting at Cardiff.

June 5-8.—I.G.E.—Annual General Meeting, London.

EDITORIAL NOTES

Throughput per Retort

DURING the past few months we have been able to record in the "JOURNAL" the results of outstanding work carried out at Birmingham on carbonization in continuous vertical retorts. In October last Mr. S. K. Hawthorn put in a plea for closer control of the cracking of the vapours evolved during carbonization, while in January of this year Mr. E. B. Tomlinson, Engineer-in-Chief to the Birmingham Gas Department, gave a most valuable account of what has already been accomplished in this direction. In our issue to-day Messrs. F. H. Bate and A. R. Myhill, of the Windsor Street Works of the Department, deal with the important question of coal throughput per retort, making out a very strong case for maximum throughputs. Their contribution, which is an extract from a paper before the Midland Junior Gas Association, is opportune and welcome, and it certainly merits attention, as also does the discussion to which it gave rise.

The authors properly emphasize that the highest make of gas per ton does not by itself necessarily constitute the best carbonizing practice. The aim should be the cheapest therm, which is dependent to a very great extent on the maximum amount of coal which can be efficiently carbonized per retort, and it may well be a good policy to sacrifice a small amount of the make per ton in favour of a higher output per retort. But at Windsor Street increased throughput has actually been accompanied by an increase in therms per ton. Tests carried out at the Coal Test Works at Nechells show what increase in therms per ton may be obtained by increased throughput—77·6 therms, as against 74·3. The advantages of high throughput are many. Labour charges are lowered, and this means a great deal to the larger works. What it means at Windsor Street will be appreciated by mentioning that the retort house comprises about 270 W-D retorts with capacities ranging from 6 to 10 tons each per day. The plant, we understand, holds two world records. It is the largest continuous vertical retort house expressed in terms of daily carbonizing capacity, and since its inception in 1912 has carbonized more coal than any other vertical retort installation in the world. Another advantage is the reduction of fuel costs. The heat losses of the setting—radiation and convection—remain constant irrespective of throughput. If the throughput is increased by, say, 20% it does not follow that the fuel supply must be increased by 20%. Again, capital and repair charges are less. Lower repair charges are proportionate to the increase in the throughputs coupled with a decrease in spalling of the silica. A further advantage claimed by Messrs. Bate and Myhill is the production of a better coke—a matter referred to subsequently in the discussion on the paper.

The whole story of the continuous vertical plant at Windsor Street is full of interest—how by largely cutting out recuperation of secondary air it has been possible to increase the producer grate area in the same setting space, a necessary increase to obtain maximum throughputs. Surplus heat from the settings is now utilized for steam raising. Naturally the question of combustion chamber temperature is dealt with in the paper. Many engineers impose restrictions on the maximum temperature to be attained in the combustion chambers, with a view to prolonging the life of the setting. This, state the authors, is a sound policy, "but it is still possible to secure a greater supply of heat, while remaining within the temperature limits, by making full use of the auxiliary secondary air if any is provided, or, in an upwardly heated installation, by altering the size or shape of the nostrils." And more than one speaker in the discussion stressed the fact that what may be termed volume of heat is of more importance than high temperatures persisting only for a short length of the combustion chamber.

Upwardly Heated Verticals

THE foregoing contribution is not confined solely to the subject of increased throughputs, for the authors offer several valuable suggestions regarding the general working of continuous vertical retorts and also discuss the application of upward heating. Their remarks on keeping all retorts operating at their proper speed are much to the point, and what they say about selection of coals is worth underlining. Some coals are difficult to carbonize, others relatively easy. In the term "carbonize" is included the capacity to steam to the required calorific value with high throughput. If it is not possible to avoid the difficult coals, it is preferable to allocate them to certain retorts, arranging throughput to suit, and to reserve the remaining coals for the rest of the plant, when improved average carbonizing results are likely. And in this regard the account of a special coal feed to the retorts is most interesting. The feed is "well worth trying on difficult retorts or when working troublesome coals." At any rate at Windsor Street the introduction of these "trunk feeds" met with immediate success. The necessity for scurfing is now less frequent and labour costs have been substantially reduced. In the discussion Mr. G. C. Pearson, Engineer of the Station, explained that the installation of the feeds on the 7-ton plant resulted in a reduction of 25% in the labour required.

Another topic of importance considered by Messrs. Bate and Myhill is the upwardly heated retort. Many advantages are claimed for this type of setting—easier coal travel, longer life, longer periods between scurfing, higher thermal yields, and increased steaming efficiency. A range of upwardly heated retorts has been erected at the Windsor Street Works. It consists of 66 retorts heated by an external battery of producers; and what the authors of the paper have to say about it is eloquent testimony of the efficiency of the plant.

The Gum Problem

FOR the past thirteen years the laboratories of the United Gas Improvement Company of Philadelphia have been studying this problem in its various aspects, and we feel we have done good service by keeping our readers informed of the progress of this important investigation. It is now established that there are two distinct types of gum which may be formed in town gas. The first type is liquid phase gum, apparently formed by the polymerization and oxidation of unsaturated hydrocarbons, primarily styrene and indene. The rate of gum formation, which is the result essentially of oxidation, is greatly increased by increase of oxygen in the gas and by the presence of small quantities of sulphur compounds of the mercaptan type, which act as catalysts. A remedy is to remove from the gas such an amount of styrene and indene that a negligible quantity will be deposited in the distribution system, and this can be accomplished by oil washing, among other methods. The other type of gum

is vapour phase gum, which presents an entirely different problem. This gum is dispersed in the gas in the form of very fine particles, and its formation is due to the reaction of several hydrocarbons with oxides of nitrogen. The major source of the latter is the oxides of nitrogen in the products of combustion in the settings surrounding the retorts. Here, again, one remedy is to remove the oxides of nitrogen from the gas. A satisfactory process for such removal was developed by the United Gas Improvement Company, and was referred to in the "JOURNAL" for Nov. 23, 1932. In our issue to-day we publish a paper by Mr. Fulweiler before the last convention of the American Gas Association—a contribution which shows what developments have taken place in providing a solution to the whole gum problem. In the author's words, "the advance made during the past year encourages us to hope that at the present rate of progress another year's work will furnish solutions for all the more important features of the gum problem."

It will, we think, serve a useful purpose if we call attention here to one or two of the main findings of the recent work. First, vapour phase gum is not confined to coal gas, for water gas plants may produce large quantities of this gum. In one plant investigated, crude carburetted water gas contained more nitric oxide than the usual crude coke oven gas. Fortunately, however, the purifiers appear to remove the nitric oxide from carburetted water gas more rapidly and efficiently than they will remove it from coke oven gas, and, in addition, there is generally a marked drop in the nitric oxide content in the storage holder. In 1932 Mr. Fulweiler stated, with some reservations, that if the nitric oxide at the outlet of the plant could be kept below 6 grammes per million c.ft., little trouble need be expected from gum stoppage. He now reports that there appears to be no safe lower limit; even quantities of nitric oxide below 2 grammes per million c.ft. will, if the gas is held in the distribution system sufficiently long, form sufficient gum to cause pilot stoppages. Everything points to the necessity for complete removal of nitric oxide. The process for the removal of this constituent involves a modification of the operation of oxide of iron purifiers, and several plants have operated the process with every satisfaction. To quote Mr. Fulweiler, "for plants that have available somewhat more than the normal amount of purification capacity our process would appear to give a practical solution of the gum problem." A modification of the process that involves the removal of the oxygen from the gas has been operated on a semi-plant scale. This completely removes the nitric oxide, so that with freedom from oxygen liquid phase gum formation would be largely prevented and corrosion practically eliminated. It is explained that at present the operating costs are high, but it is hoped that further experiments may result in decreasing them. Such a process would promise a final solution to both the vapour phase and the liquid phase gum problems.

The Price of Gas Appliances

A FREQUENT topic of discussion, especially among the younger members of the Industry, is the cost of gas appliances. We often, for example, come across a plea to the makers for lower prices in the discussions which take place in the Salesmen's Circles. In the interests of the Industry we heartily endorse the demand for domestic appliances at as low a cost as possible, but we must qualify it by asking for *efficient* appliances—or, shall we say, a continuation of the increasing efficiency which recent years have brought. Not long ago we viewed, almost as a museum piece, one of the early cooker thermostatic controls, and when we say early in this case it is not going so very far back. Then comparing this with its modern counterpart, and the price of the cooker with its equivalent of only some ten years ago, we realized the advance which has been made.

This advance is perhaps in some ways a two-edged sword, because the more rapid the development in domestic appliances, the faster the increase in obsolete pieces on the district. But against this it can be argued that the modern gas appliance, both from the utility and the æsthetic point of view, should satisfy the householder for a long time, and that further refinements are rather in the nature of painting the lily. In the absence, therefore, of quite startling developments either in our own or any other industry, it is not to be expected that the domestic appliances which are being put out to-day will cause gas undertakings any anxiety for years to come.

Our main reason for raising this subject is that we cannot conceive of any more discouraging start for the gas salesman than a feeling that the goods he has to offer are over-priced. Our object is not to encourage the makers to keep up prices; but then is not competition among themselves a fairly strong safeguard against this? We repeat that we want for gas undertakings the most efficient apparatus possible at the lowest possible cost, but we must urge on those who are hard pressed to realize as most do, but by no means all, that the main object in life of a gas appliance is to sell gas, and not to make a direct profit on its own sale. Our chief competitors carry this principle to extreme lengths.

Finally, in considering the question, apart from a rough assessment of the probable intrinsic costs of the modern gas appliance which anybody can make, we must not forget the continuous scientific research which has led up to present-day efficiency, and which we all hope the makers will continue. Then we must remember their national advertising, which we think the Industry would sadly miss if it were stopped. And, lastly, let us not forget the innumerable calls upon them for local assistance—in exhibitions, in displays, in demonstrations. Indirect advertising for themselves, no doubt, but direct and valuable advertising for the gas undertakings.

Where is the Gloom?

WE learn from the current issue of the *Electrical Times* that "there is no doubt that the gas interests are becoming seriously alarmed. This anxiety is visible in their trade papers, it is painfully visible in the municipal policy of holding electrical development in check. By fair means or otherwise gas is doing its utmost to dam back the rising tide of electricity."

Naughty municipalities! The electricity undertakings will have to promote Bills in Parliament to free the citizen from gas tyranny. But what gas interests are becoming seriously alarmed? In spite of the fair means —or otherwise—employed by our competitors, we detected no alarm in the speeches of the many able Chairmen who have presided over gas company meetings in recent months. Even the "otherwise" means employed by our competitors, to which some of them referred, gave rise only to a setting of teeth in the joy of combat. Nor do we detect much sign of alarm among that very very large section of gas interests which is represented by thousands of shareholders.

And the trade papers? We do not think that the electricity interests can have derived from the "JOURNAL" very much of the encouragement they so badly need in their plan to encompass, by fair or "otherwise" means, the speedy demise of the Gas Industry.

PERSONAL

Association of Tar Distillers.
New President.

[*Photo. by Elliott & Fry, Ltd.*

J. REGINALD LANE.

The new President of the Association of Tar Distillers, Mr. J. Reginald Lane, was born in 1887, and was educated at King Edward VI.'s Grammar School, Lichfield. He received his chemical training at the Brownhills Chemical Works, owned by his family. Mr. Lane is associated with the following Tar Distilling Companies: Chairman of Directors of Lancashire Tar Distillers, the Normanby Park Tar Supply Company, Ltd., and the North-Western Co-Operative Tar Distillers, Ltd., Deputy-Chairman of the South-Eastern Tar Distillers, Ltd., and Director of Messrs. Lennard & Co. (Shoreham-by-Sea), Ltd., &c.

DIRECTORATE OF LIVERPOOL GAS COMPANY.

In the Liverpool Gas Company's Co-partners' Magazine is the announcement of the resignation of Mr. Alfred Tyrer from the Board. Mr. Tyrer was appointed a Director in 1900 and became Deputy Chairman in 1921. For the past thirteen years he has been a member of the Co-partnership Committee. The association of Mr. Tyrer's family with the Gas Industry dates from 1818 when Liverpool's first Gas Company was incorporated by Act of Parliament. In the preamble to the Act the names of Mr. Tyrer's grandfather, father, and uncle are included in the list of promoters of the Company.

Mr. Ernest Bland Royden has accepted the seat rendered vacant by the death of Mr. John A. Tinne; and the vacancy caused by Mr. Alfred Tyrer's resignation has been filled by the appointment of Mr. A. Kenney Tyrer, his son, to the Board.

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In last Saturday's issue of the *Barnet Press and Finchley Borough News* was published a photograph of Mr. W. A. BARNETT, J.P., Assistant Engineer and Works Manager to the Barnet District Gas and Water Company. Mr. Barnett, who has just been appointed Chairman of the East Barnet Valley Council, and has been a member of the Council since 1926, entered the service of the South Metropolitan Gas Company in 1912, at the Greenwich Works. Early in 1919 Mr. Barnett became Assistant Engineer (Mechanical) at the Nine Elms Works of the Gas Light and Coke Company, and in the following year he was appointed to his present position. Mr. Barnett is an associate member of the Institution of Mechanical Engineers and of the Institution of Chemical Engineers.

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Mr. THOMAS CARMICHAEL, Engineer and General Manager of the Portsmouth Gas Company, has been elected a Member of the Institution of Civil Engineers.

OBITUARY

Mr. JAMES THOMPSON, Senior, Governing Director of John Thompson Associated Engineering Corporation, and a Director of the Bilston Gas Light and Coke Company, died on the liner "Laconia" in the Mediterranean on April 15. Mr. Thompson, who was 71, was Mayor of Wolverhampton for two years from 1920 to 1922.

THE NEWS OF THE WEEK

An Electricity Failure occurred on the night of April 10 which affected the whole of the town of West Bromwich for some minutes shortly after 7 p.m.

Oriental Gas Company, Ltd.—The Directors have resolved to pay, on May 31, an interim dividend at the rate of 3½% free of income-tax, on account of the year ending on June 30 next.

An Inquiry Will Be Held at the Board of Trade Offices on April 27 into an application by the Huthwaite Urban District Council for a Special Order under the Gas Undertakings Acts, 1920 and 1929.

The Health Congress of the Royal Sanitary Institute will be held at Bristol from July 9 to July 14 under the Presidency of Dr. Stanley H. Badcock, Pro-Chancellor and Treasurer of the University of Bristol.

The "All-Gas" Exhibition House in Greenhill Road, Allerton, which was opened in March by Lady Cozens Hardy, attracted many thousands of visitors. On Sundays and over the Easter holidays the daily attendance was about eight hundred.

Free Gas Services, in approved cases, are to be installed at Yeovil, including three lighting points and a cooker, on condition that the applicants agree to pay for their gas by slot meter at a rate of 1d. for 15 c.ft. instead of the ordinary rate of 17 c.ft. for 1d.

According to the Minutes of the Gas Committee members of the Burton-on-Trent Town Council are to be invited to be present at the official ceremony of the filling with gas for the first time a new 1,000,000 c.ft. holder. The holder has been under construction for six months.

A Windfall of £2,595 has been received by the Grangemouth Town Council. The Burgh Chamberlain reported to a meeting of the Gas Committee last week that as a result of negotiations extending over eighteen months with regard to the claim for repayment of income-tax, consequent upon the reconstruction of the gas-works in respect of obsolescent plant, a complete settlement had been reached with the Inspector of Taxes, with the result that £2,595 was to be repaid to the Gas Commissioners. The meeting congratulated the Burgh Chamberlain on the success of his negotiations, and it was agreed to remit to him to consider and report how the sum should be applied.

SIR ARTHUR DUCKHAM MEMORIAL FUND

Official List of Donations from April 14 to April 20

The Committee hope to be in a position to endow a "Duckham Research Award," to be applied for the period and purpose of specified investigations of interest to the Gas Industry, at places, at home or abroad, selected as being appropriate for the conduct of each particular investigation. Subscribers, therefore, are not only paying a tribute to the memory of Sir Arthur Duckham, but are also assisting to strengthen the Gas Industry at a critical period of its development.

Name and Town.	Amount. £ s. d.
Altrincham Gas Company	10 10 0
Annan Gas Company, Ltd.	1 1 0
Bristol Gas Company	100 0 0
Chester United Gas Company	10 0 0
Corbridge Gas Company	1 7 0
Samuel Cutler & Sons, Ltd., London	5 5 0
Harold Davies, Chesterfield	1 1 0
Robert Dempster & Sons, Ltd., Elland	5 5 0
Featherstone Gas Company	2 0 0
Frodsham Gas and Water Company	2 2 0
G. M. Gill, London	3 3 0
Glenboig Union Fire Clay Company, Ltd., Glasgow	10 10 0
T. B. Glover, Buenos Aires	2 2 0
Guildford Gas Light and Coke Company	10 10 0
T. W. Harper, Ayr	2 2 0
Hexham Gas Company	3 3 0
H. J. Hodsman, M.B.E., Leeds	1 0 0
D. F. Irving, Leatherhead	3 3 0
Jersey Gas Light Company, Ltd.	5 5 0
Long Eaton Gas Company	5 5 0
Reading Gas Company	52 10 0
H. M. Royle, Southend	1 1 0
Rushden and Higham Ferrers District Gas Company	5 5 0
G. Stevenson, Long Eaton	1 1 0
Woodall-Duckham Companies: Directors and Staff (Second Donation)	100 0 0
Donations (25) paid above	£ 344 11 0
Donations (469) paid previously	8,587 12 6
Total Donations (494) paid	£8,932 3 6
Donations (14) promised	£ 681 7 0
Total Donations (508) paid or promised	£9,613 10 6

Price Reduction.—The Bridgnorth Gas Committee has decided to reduce the price of gas in the town to 3s. per 1,000 c.ft. as from the beginning of the present quarter. The price hitherto has been 3s. 3d. and 3s. 4d. per 1,000 c.ft., and the reduction to slot meter users will be 4d. per 1,000 c.ft.

A Home-Made Gas Pipe Connection, to secure a renewed supply after the local Gas Undertaking had cut off the supply, brought Herbert Scales, of The Nook, Cleckheaton, into Court last week, when he was ordered to pay £3, including costs, for laying a pipe without the local Gas Authority's consent. The poor piping connection caused a bad smell of gas and considerable danger.

Colloidal Fuel.—In his address as Chairman at the annual meeting of the Cunard Steamship Company, Ltd., Sir Percy Bates stated that progress in the experiment of burning coal and oil in combination had been going on steadily, and the result of all tests had confirmed the discovery, which had now passed to the point where, in conjunction with other important interests, the question of its commercial development was being actively pursued.

New Coldstream Gas Company.—The Coldstream gas undertaking has been formed into a joint stock company bearing the designation of the Coldstream Gas Company, Ltd., 5, Tweed Terrace, Coldstream. It has been formed to manufacture, sell, and supply gas and electricity in the town and suburbs of Coldstream, Berwickshire, and in any other towns or parishes in which the Company may from time to time be authorized to supply. It has a capital of £4,000 in £1 shares.

Fuel Technologist Required.

The Secretary of the Institution of Gas Engineers is informed that the Public Service Board of New South Wales invites applications for the position of Fuel Technologist. The salary of the position will be that fixed for Geological Surveyors, Grade A, present rate £576 15s. 4d., ranging to £626 15s. 4d., reduced under the New South Wales Public Service Salaries Acts to £476 8s. 3d., ranging to £515 14s. 11d. per annum.

Applicants should be graduates in Engineering or Science and have had practical experience in the treatment and utilization of coal, including the operation of the processes for the carbonization of coal and recovery of products, the application of scientific methods for the production and utilization of fuel, treatment of tars for production of motor spirit and other oil fuels, and in fuel research work generally. The salary will be paid from the date the selected applicant arrives in Sydney. The steamer fares of appointee and his family will also be met, besides payment of a shipment board and incidentals allowance of £20.

Six copies of applications and any supporting papers should be forwarded to the Official Representative of the Government of New South Wales, Wellington House, 125, Strand, London, W.C. 2, not later than May 31. No special form of application is provided.

Gas and Electricity Share Fine New Showroom Premises at Warrington.

The opening of the joint gas and electricity showrooms at Warrington, of which brief mention was made in these columns last week, took place on April 13, when the Chairmen of the Gas and Electricity Departments performed the official ceremony in connection with their respective sections, and afterwards entertained those who had attended at dinner in the Town Hall.

The building is situated in Buttermarket Street, on land belonging to the Corporation, and has a frontage of over 90 ft., being built in a restrained Georgian style, following the contour of the street. Externally, Portland stone has been used for the base and the recessed pilasters; with a filling of 2-in. sand-faced bricks, of a warmish tint; with the arches over the upper windows in a darker tint from the rest of the facings, and relieved with a projecting stone key block.

In the centre of the façade is a pedimented architrave, forming a main entrance. Above this entrance the stonework is carried up to the full height of the front and is embellished with the Coat-of-Arms of the Borough sculptured in the masonry, the whole building being surmounted by a "Classic" cornice and a parapet wall.

There are three floors in the building devoted to show space. The windows to the ground floor showrooms are in bronze frames surmounted by a black opal glass facia with inserted signs, lighted from behind. The windows to the first and second floors are steel pivoted casements in English oak frames.

Although the Gas and Electrical Departments are housed in the same block of buildings, they are two entirely different units and worked independently of each other—in fact, they are divided by the Tramways Offices.

The opening of these showrooms marks another step in the history of the Warrington Gas Department, and the new premises have been designed still further to develop practical demonstrations of the various apparatus. In connection with the official opening, afternoon and evening cookery lectures were arranged daily for the first week, including demonstrations of various appliances.

Alderman J. Wood (Chairman of the Gas Department), declaring the gas showrooms open, said it was forty years ago since the Gas Department opened its first showrooms in

THE NEWS—*continued.*

a small upstairs room in Mersey Street. Fifteen years later, the second one was built, and had now been closed, and were to be followed by the new commodious premises. Originally, the turnover of the Department was £1,000 a year, and a recent return showed an annual turnover of £16,000. He thought they would agree that the Gas Department had made another step forward that day, and that they were all very proud of the new showrooms. He wished the Department and everyone associated with it prosperity and success.

A Sales Analysis.

What special publicity efforts pay best? Widnes, a Municipal Undertaking of round 350 millions, has answered the question for itself by a careful analysis, the interesting details of which we are able to give through the courtesy of the Engineer and Manager, Mr. C. E. Dickinson.

Showrooms were opened in December, 1926, and a review of the Gas Department sales for the seven years since that date gives the following results:

Year.	Cash.	3 Years' Hire-Purchase.	5 Years' Hire-Purchase.	Total.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1927 . .	781 18 6	1,711 8 6	1,056 6 0	3,549 13 0
1928 . .	656 4 2	1,221 13 0	2,080 11 0	3,958 8 2
1929 . .	674 11 9	1,397 10 5	2,816 7 7	4,888 9 9
1930 . .	840 1 7	982 11 11	4,027 4 1	5,849 17 7
1931 . .	1,078 1 8	1,083 12 0	5,714 10 6	7,876 4 2
1932 . .	928 17 3	931 10 8	8,341 1 8	10,201 9 7
1933 . .	931 16 1	619 6 0	13,763 12 8	15,314 14 9
Total . .	£5,891 11 0	£7,947 12 6	£37,799 13 6	£51,638 17 0
Average .	£841 13 0	£1,135 7 6	£5,399 19 0	£7,376 19 6

These figures show the popularity with consumers of hire-purchase terms spread over a long period.

The seven years' analysis covers 2,010 gas fires, 3,605 cookers, 1,052 water-heaters (*plus* 448 on simple hire), 60 grillers, 175 radiators, 255 geysers, 207 heaters, 50 washcoppers, 191 gas irons, and 2 gas-operated refrigerators—a total of 8,053 appliances.

It is interesting to investigate the method by which sales were effected. For instance, during the year ended December, 1933, the total sales, amounting to £15,314 14s. 9d., were obtained as follows:

Sales Effected—	£ s. d.
At showrooms	7,314 8 7
By distribution workers	5,180 2 6
By showroom attendant during morning canvass*	414 5 9
At two exhibitions (held in spring and winter)	394 8 5
By showroom attendant and distribution workers during a special canvass for "Newlyn" water heaters	496 13 3
By manufacturers' representatives and distribution workers during a special canvass for water heaters	1,100 16 0
At an all-gas exhibition house	414 0 3
Total sales for 1933	15,314 14 9

* The showroom attendant canvasses the district during the morning of each day. The amount shown represents the sales resulting from this canvass, and does not include the sales effected by the attendant as a result of distribution workers' inquiries. Such sales have been credited to the distribution workers.

It is interesting to note that the sales for 1933 worked out at 30s. per head of consumers.

Horsham Company Hold Successful Exhibition.

For many years past the Horsham Gas Company, Ltd., have held an Exhibition of gas appliances at which practical cookery demonstrations have been given. This year's Exhibition, which has just been concluded, is the most successful yet arranged, and large attendances throughout the entire week afforded ample proof of the feminine interest in cooking by gas.

All the apparatus on view was by John Wright & Co., Ltd., and included a wide selection of cookers, gas fires, "K.C.U." water heaters, and other appliances by this firm. Miss Baker, first-class diplomée N.S.T.C., of Radiation, Ltd., demonstrated the making of favourite dishes and cakes in a "Eureka" "New World" cooker, and much interest was evinced by the audience at each demonstration in the complete dinner cooked perfectly in a padlocked cooker which was unopened until the end of the cooking period. A Cake-Baking Competition for which several prizes were awarded brought 77 entries, and was won by a consumer using a "Eureka" "New World" cooker. The prizes were presented at the concluding demonstration by Mr. J. W. Halstead, Managing Director of the Horsham Company, who, with his staff, is to be congratulated on the success of the exhibition.

Western Junior Gas Association.

Annual Meeting at Bath.

On April 14, the Association assembled at the Works of the Bath Gas Company, and parties made a tour of the Works. The Annual Meeting was held later in the Demonstration Room at the new Showrooms and the minutes of the previous Annual Meeting were read and confirmed. The President (Mr. S. Hole, Bath) explained that the services of Mr. K. L. Clark (Weston-super-Mare) had been secured for the position of Hon. Secretary after Mr. Bateman's promotion, and that Mr. B. F. Harris (Trowbridge) had taken over the duties of Hon. Treasurer.

ELECTIONS OF OFFICERS.

President.—S. Hole (Bath).
Senior Vice-President.—D. L. Copp (Exeter).
Junior Vice-President.—S. B. Jones (Clevedon).
Hon. Secretary.—K. L. Clark (Weston-super-Mare).
Hon. Treasurer.—B. F. Harris (Trowbridge).
Hon. Auditors.—J. F. Marlow (Weston-super-Mare) and H. W. Randall (Stroud).
Council.—J. T. Spencer (Weston), A. Tran (Bath), J. W. Denton (Torquay), and A. Farquhar.

The Secretary's report having previously been circulated, was taken as read, and the Hon. Treasurer's report was read and adopted.

The President announced that the Council had voted a contribution to the Arthur Duckham Memorial Fund.

Mr. D. L. Copp then took the chair and called on Mr. Hole to give his Address, which will be published in next week's "JOURNAL."

Mr. Copp proposed and Mr. J. H. Dyde (Plymouth) seconded a hearty vote of thanks to the President for his Address, to which Mr. Hole replied.

Efficiency of Gas Manufacture.

In a paper before the Institution of Mechanical Engineers on Friday last Mr. F. M. Birks, of the Gas Light and Coke Company, compared the working results which can normally be obtained from four types of carbonizing plant, assuming that waste-heat boilers are provided to recover the sensible heat in dry-quenching the coke as well as in the flue gases. The figures given for dry coke and breeze refer to the net residue after supplying the producers with their requirements.

TABLE I.—*Average Results Obtained when Carbonizing Durham Coal in the Different Types of Plant Described.*

[Results per ton of coal having a thermal value of 310 therms.]

—	Continuous Vertical Retorts.	Intermittent Vertical Retorts.	Coke Ovens.	Horizontal Retorts.
Gas, calorific value, B.Th.U. per c.ft.	510	510	580	500
Gas, c.ft.	15,300	16,080	12,400	13,200
Dry coke,* cwt.	10·0	9·85	11·55	10·2
Dry breeze,* cwt.	1·5	1·3	0·9	1·5
Tar, galls.	10·0	11·9	9·0	9·4
Thermal account (therms)—				
Gas	78	82	72	74
Coke and breeze*	163	157	180	167
Tar	18	22	16	17
Surplus steam	14·2	13·55	11·8	14·45
Steam account (therms)—				
Steam raised—				
(1) From waste gases	15·4	7·5	..	9·1
(2) From hot coke	..	6·5	7·5	5·9
(3) From hot coal gas	1·3	1·5	4·3	0·9
Total	16·7	15·5	11·8	15·9
Less steam used—				
(4) By waste gas fans	0·2	0·15	..	1·45
(5) By steaming retorts	2·3	1·8	..	..
Surplus steam (as above)	14·2	13·55	11·8	14·45
Thermal efficiency,† %	88·1	88·6	90·3	87·9

* Surplus after providing producer fuel.

† We have taken the liberty o including in this table, which will doubtless prove a valuable reference, the thermal efficiencies of the different types of plant. —ED. "G.J."

In the steam account two or three items may call for explanation. It is not possible to generate steam from

the waste gases in a coke oven plant because the complete system of regeneration employed results in a low outlet temperature to the stack. It is, however, possible to fit boilers to the ascension pipes and thus to raise steam in addition to heating the feed water by the gas leaving the ascension pipe boilers. In the horizontal, intermittent vertical, and continuous vertical retorts, the heat is recovered from the gas by heating the feed water for the boilers, and the amount of heat which can be recovered in this manner depends upon the amount of feed water used. The extremely small amount of heat shown as utilized in the waste-heat boiler fans of the continuous and intermittent vertical plants is due to the assumed use of back-pressure turbines for supplying the steam to the retorts for steaming purposes. The heat drop in the turbine is therefore the only portion shown against the fans in the steam account, while the remainder is charged to the retort steaming process. This system has not been adopted in the horizontal houses, as steaming is not usually practised and no other use for the low-pressure steam has been found.

New Plant at Rothesay Gas-Works.

On Friday, April 20, new plant for the utilization of waste heat was officially put in operation at the Rothesay Gas-Works. The ceremony was performed by Baillie W. Jack, the Convener of the Rothesay Corporation Gas Committee, in the presence of a company of gas engineers and members of the Rothesay Town Council.

The plant was erected by West's Gas Improvement Company, Ltd., Manchester, who were also responsible for the vertical retorts at present in operation. A Spencer-Bonecourt boiler has been fitted and receives the waste gases from the setting. A supply of steam sufficient for the entire works is thus generated. The plant is completely automatic in operation, and a fuel economy of 2 tons of coal per day is being effected.

After the ceremony a luncheon was held, and Provost Thomson presided. The speakers at the luncheon included Provost Thomson; the Rev. Wm. Runcimann, the Convener of the Johnstone Gas Committee; Baillie Buchanan, and Dean of Guild Buchanan, Rothesay; Messrs. G. Braidwood, Coatbridge; A. S. Nisbet, Paisley; and D. Fulton, Helensburgh.

Exhibition of Chemical Plant.

The Seventh Achema.

Six successful exhibitions of chemical plant and apparatus have been organized, at intervals of two to four years, by the Dechema (Deutsche Gesellschaft für Chemisches Apparatewesen). The seventh Achema is to be held in Cologne from May 18 to 27. During this period, also, a number of societies and institutions will hold conferences in Cologne and its neighbourhood. Among these may be mentioned the 47th General Meeting of the Verein Deutscher Chemiker—the parent Society of the Dechema.

In order that intending visitors may be well-primed as to what they may see at the exhibition, decide what particular exhibits are of most interest to them, and ascertain the locations of the stands concerned, the Achema Handbook, 1931-34, has been published. This volume, recording progress since the last exhibition and containing upwards of 200 pages, will, so far as the edition permits, be forwarded free of charge, up to May 10, to those who may contemplate visiting the exhibition. Application, accompanied by R.M.0·40 to cover postage, should be made to Dechema, Seelze bei Hannover, Germany. After May 10, a charge of R.M.10 will be made.

The volume records the melancholy fact that Dr. Max Buchner—the founder of the Dechema and the originator of the Achema exhibitions—died on April 10 last, just three days after he had seen the book through the press.

The Achema Handbook is divided into a General Section, a Scientific Section, a Technical Section, and a list of exhibitors and exhibits. The first section gives a history of the Verein Deutscher Chemiker and the Achema and short biographical notes concerning eminent Rhineland chemists whose names have been given to the avenues along which the stands are grouped in the exhibition. The scientific section commences with a very readable account of the history of the development of chemical apparatus and plant contributed by Dr. Buchner. This is followed by chapters on the standardization of laboratory apparatus, the welding of chemical plant, the measurement of ultra-violet light, and the Drawinol process for the dehydration of alcohol. It is to be noted that the standardization of chemical glassware in Germany is very much more advanced than in this country.

The technical section contains contributions by many of the exhibitors, who describe some of their newest developments under the headings: Constructional materials; scientific apparatus and methods used in industry; large-scale plant, machinery, and processes. Mention may be made of a few of these developments—corrosion resisting steels and alloys, nickel and its alloys in chemical industry, cast chrome steels, glass-lined plant, photo-electric apparatus, X-ray apparatus, temperature recorders and regulators, acid pump, electric induction heaters for gases and liquids, high-pressure plant, and electrolytic hydrogen plant.

The reading matter is, as indicated above, followed by a list of stand-holders and a classified list of products with key-numbers by means of which the exhibitors may be identified.

In view of the fact that the list contains the names of some three hundred of the best known German manufacturers of chemical plant and apparatus for all purposes, there is no doubt that the exhibition will be of extreme interest. It remains but to add that the requirements of the Gas Industry are well represented.

A Link with Henry VIII.

Our photograph shows an effective topical window display arranged recently by the Swansea Gas Light Company, providing an amusing "link-up" with the well-known film featuring Charles Laughton as Henry VIII. running concurrently at a local cinema.

Gas in the Glass Industry.

A B.C.G.A. Publication.

In the manufacture of glass the number of processes in which an accurately controlled heat is of primary importance are so many that it is only natural that the cleanliness and controllability of gas commend this fuel to manufacturers. Indeed, as is pointed out in "Town Gas in the Manufacture and Manipulation of Glass," an illustrated booklet produced recently by the British Commercial Gas Association, the number of glassworks and factories using gas for manipulating glass in one way or another is enormous.

This booklet (No. 239 of "A Thousand-and-One Uses for Gas") contains much interesting information about the processes in glass manufacture in which gas helps to improve the finished product and to reduce the number of rejects.

Gas Progress in Timaru.

"I am very pleased, considering the times, to find that we are able to present such a good balance-sheet," said the Chairman of Directors of the Timaru (New Zealand) Gas, Coal, and Coke Company, Ltd. (Mr. J. P. Newman), in moving the adoption of the annual report and balance-sheet at the fifty-ninth annual meeting of shareholders.

The balance-sheet, said Mr. Newman, enabled the declaration of a small dividend which would make a total

THE NEWS—*continued.*

dividend for the year of 5%. This, he said, would have seemed a small return a few years ago, but in view of what had been happening in the world at large, 5% to-day could be regarded as a reasonable return. They had experienced a somewhat trying time as one could not tell from month to month what the result of the year's working was likely to be. He thought, however, that considering the restricted area in which the Company operated, it had done rather well. Generally speaking, the figures in the balance-sheet were much the same as the previous year. The reserves now amounted to £30,214, compared with £29,065 last year. The Directors had made ample provision for depreciation throughout the services, the amount this year for that purpose being £2,416. Stocks of coal, coke, tar fittings, mains, &c., were valued at £6,060 as against £5,830 last year, while liquid assets totalled £5,131. In the revenue account wages and material this year amounted to £12,567, and last year the figure was £11,981. Sales of gas, coke, tar, and sundries amounted to £24,049 as against £24,466 last year.

Mr. Newman said that during the year the business of the Company had been conducted on a safe basis. The plant and works were now generally in a state of very much greater utility, and the appearance of the works site had been greatly improved. In this direction credit was due to the Engineer and Manager (Mr. A. Morrie Taylor), to whom the Directors realized they owed a great deal for his care and foresight. The plant had never been more complete or more serviceable than at the present time.

Minehead Company's Progress.

New Showrooms at Dunster.

Following the extension of their service to Dunster, about two and a half miles away, a few years ago, the Minehead Gas Light and Coke Company have just opened new branch showrooms at West Street, Dunster, where they are displaying the latest gas appliances.

The Company continue to increase their business and have now under consideration the extension of the supply to Porlock, a growing place about seven miles to the west of Minehead.

Humanizing the Gas Industry.

Last night Mrs. Eileen Murphy, of the B.C.G.A., gave an after-dinner talk to members of the Efficiency Club at the Overseas League.

Speaking of Mr. Therm, Mrs. Murphy said: "Anyone who tries to 'sell' a great public utility is faced with one big problem. The average woman, when she thinks of an enormous concern like the Gas Industry, or a big insurance company, or a bank, is apt to think of it as something remote and inhuman. You see, the figures of investment, and output, and so on, are too big for her to grasp. And so the problem is to *humanize* the Industry in the eyes of the public—to concentrate its 'story' in one figure who can capture the imagination in the same way as Johnnie Walker, or the Kodak girl, or Mrs. Rawlins, or the Bisto Kids. Well, Mr. Therm is the Bisto Kid of the Gas Industry."

Swansea Company's Pension and Co-Partnership Schemes.

Ten years ago the employees of the Swansea Gas Light Company offered the balance of one of their charity funds towards the formation of a superannuation scheme. The Directors made a similar gesture and a scheme was formed.

At the Annual General Meeting of the members of the scheme, held last Thursday, Mr. Ernest H. Leeder, Chairman of the Company, traced the satisfactory growth of the scheme throughout the years, and expressed gratification at its present fund value of approximately £30,000.

Consideration was given to the accounts of the past year, and also to the Secretary's second quinquennial statement and report, from which it transpired that as and from Jan. 1, 1934, contributing members would be superannuated at 65 years of age, and that the receipts from contributions and from income from investments would be sufficient to meet estimated pensions in future years.

Following this meeting, the Annual Meeting of the Company's Co-partnership Scheme was held.

Mr. W. H. Johns, Engineer and Manager, in proposing the adoption of the accounts for the year, expressed the members' gratitude for the continued interest of the Directors in the scheme.

Mr. J. A. Cunniffe proposed a hearty vote of thanks to the trustees and management committees of both schemes, and Mr. Ernest Ablett (Secretary) responded.

Mr. Hugh Bellingham then proposed a vote of thanks to the Chairman, Mr. Ernest H. Leeder, for the manner in which he had conducted the meetings and, in reply, Mr. Ernest H. Leeder said it was always a pleasure for him to attend these meetings and it was on this occasion a particular pleasure inasmuch as the superannuation scheme had now passed a very important milestone. He assured the members of the Directors' continued interest in both schemes.

There were several references to the excellent work accomplished by Mr. Ernest Ablett, the Secretary, the meeting eulogizing the services he had rendered in furthering the scheme.

Coal Utilization Council.

Sales Training and Technical Work.

In a paper before the Royal Society of Arts last Wednesday, Mr. W. R. Gordon, Director of the Coal Utilization Council, explained that the Council has made plans for sales education and sales training. "We have in preparation," he said, "a text-book course in selling domestic fuel and a similar course for industrial fuel, and our object is to make these suitable for all types of salesmen at present in the trade as well as for those who will be recruited in the future. We also propose to arrange meetings at intervals throughout the course at which students can talk to experts on the various subjects dealt with. This we believe to be very desirable, but it will nevertheless be made possible for students who are unable to attend the meetings to take the course entirely by correspondence, and there will be periodical tests to ascertain that the work is being properly done and the student's interest maintained.

"We are, however, looking further than this and planning a course in sales-management and also a three-year course, on the lines of the work at Birmingham University, to prepare commercial entrants for training as executives in the higher posts of the industry later in their careers. To secure a sufficient number of entrants for these scholarships it may be necessary to conduct propaganda among parents and schools, where, unfortunately, there appears to be a widespread, but entirely erroneous, impression that the coal industry is dying.

The Technical Department.

"Another important activity of the Council has been the assistance afforded to distributors, consumers, architects, builders, and others, through the Technical Department. The services of this Department and of the competent engineers who form its staff have already found wide acceptance, and it is encouraging that the more work they do, the more they get asked to do. In addition to the chief engineer in London, area combustion engineers have been appointed for the Scottish, Northern, Wales and Midland, and Southern branches of the Council; and very shortly it should be as natural for any fuel consumer to communicate with the nearest representative of the Technical Department of the Council as it is to ring up the Post Office about telephone problems, or the local authority about the water supply. The reply will be swift, the advice given will be unbiased by any incentive to push the product of any particular firm or undertaking, and there will be no charge made for it. The Department exists for service, and to remove for good and all the reproach that fuel consumers have not been told how coal can solve their particular problems.

"It is also concerned, however, with research and with the examination of new appliances, devices for smoke elimination and similar subjects. For the present, at any rate, it is not intended that this research should be directed towards the solution of long-range problems coming more properly within the scope of the geological, chemical, and physical sciences, and involving protracted and patient experimental work. What is felt to be more immediately needed is investigation into the practical and commercial application of such developments as have been brought to a stage at which they show possibilities of being useful to the coal industry and trade, as well as to the consumers of fuel."

Compressed Gas for Transport.

Referring to the use of town gas for road transport, Mr. Gordon said that if 20 c.ft. per mile run be taken as a fair average consumption for a 20-h.p. van and 15,000 c.ft. per ton of coal as normal production, it will be seen that 100 vehicles, each running 20,000 miles per annum, will consume 40 million c.ft. of gas, requiring the carbonization of

about 2,700 tons of coal. It is, of course, impossible to estimate the number of vehicles that might be converted or constructed to run on gas, but it may be mentioned that there are 10,000 organized omnibuses alone in the country. If all of these were to be converted and to run 20,000 miles a year at 40 c.ft. to the mile, a new market would be created for 8,000 million c.ft. of gas and for over half a million tons of British coal—a market rather larger than that of Finland at the present time. The field, however, need not be restricted to passenger vehicles, for those transporting goods or performing municipal services can be converted with advantage, provided they operate within a reasonably defined radius.

Radiant Heat and Comfort.

In a paper presented to the members of the Institute of Fuel at the Engineers' Club, Albert Square, Manchester, on Tuesday, March 20, Dr. Harold Hartley, Head of the Research Department, Radiation Ltd., said that it may not be possible to attain comfort even with radiant heat irrespective of the air temperature. The air even in the English climate can be too cool to permit of comfort being attained with the aid of a radiant fire. While the effect may to some extent be accentuated by movement of the air, the movement in living rooms is generally so slow that it is the temperature of the room itself which is the determining factor. It must be remembered that radiant heat falls only on those portions of the body which can "see" the source.

With such modern types of heating appliance as permit of rapid and controlled variation in the output of radiant heat, it is, however, more easy to attain comfort than when there is dependence solely upon a source giving off convected heat.

The main part of Dr. Hartley's paper concerns some of the reactions of the human body to radiant heat of appreciably high intensity.

The work which he detailed, and for which Radiation Ltd. are responsible, leads to the following conclusions:

1. Much higher intensities of radiant heat can be borne than are required usually for comfort in a living room.
2. The maximum intensity of heat that can be endured varies with the quality of the energy.
3. In general, the *threshold intensity for pain* increases with the penetrancy of the energy relative to human skin. This result in in agreement with Sonne's finding that a higher intensity of visible energy can be borne than of short infra-red energy, and of short infra-red energy than of long infra-red energy.
4. The *threshold intensity for pain* is affected by the general condition of the portion of the body exposed to the heat, being the higher the greater the capillary flow and the more moist the skin.
5. Under the influence of radiant heat, subcutaneous temperatures much higher than blood heat can be attained and maintained.
6. The effect of a heat treatment persists for some time after the end of the exposure, and even after the subcutaneous temperature (2 mm. depth) has fallen about to the original value.
7. Sweating relieves pain, provided permanent damage to the skin cells has not been caused.

Drawbacks in the Use of Clean Coal.

In the course of a paper on the "Economic Generation of Steam in Chemical Works," by Messrs. F. H. Preece and B. Samuel, at a joint meeting of the Institution of Chemical Engineers, the Institute of Fuel, and the Chemical Engineering Group of the Society of Chemical Industry, held in London on April 18, it was stated that there has been a demand for some years to burn on steam-raising plant dirtier and finer coals and coals containing less volatile matter. This has been met by the introduction of new designs of chain grate stokers with forced draught, which is controlled separately for different sections of the stoker by the provision of compartments. A further development in the burning of cheap fuels has been the successful handling of coke breeze. This has actually been burned on chain grate stokers for practically twenty years, but the advance during the last two years has been considerable in the direction of improving the flexibility of the firing and broadening the grading of the breeze which can be burnt.

Now that such progress has been made in dealing with low-grade fuels, a new development has occurred in the preparation of coal for steam raising, according to which the manufacturers are called upon to deal with very clean coals instead of dirty ones. At the moment it seems that this development is going too far, because with the very low percentage of ash now left in some coals, in the order of 3% to 5%, there is a great danger of high maintenance of the grate. There are available chain grate stokers with thin links and fine air spacing, which stand up to the severe conditions better than the older designs having thicker masses of metal. However, in spite of this, where the ash content is very low, there is the danger of growth and burning. In one or two cases where the user has had experience of the disadvantage of burning these extremely clean fuels, it has been possible to arrange with the colliery company for sufficient ash to be left in the fuel to protect the bars. Alternatively, in other cases, ash is actually mixed with the coal delivered to the stokers for the same purpose.

An Exhibition of Refrigeration.

Work of the N.P.L.

Sixty years ago mechanical refrigeration was just coming into existence, and yet to-day it is an essential part of everyday life, not only in its well-known application of the transport and storage (including domestic storage) of perishable foodstuffs, but in many of the industries upon which this country depends. There are about 300 industries in which its use is either essential or in which it improves the quality of the product.

With the object of illustrating the part played by refrigeration and of showing the public the principles on which the several types of machines operate a special exhibition is being held in London at the Science Museum, South Kensington, the National Museum of Science and Industry, until the end of August.

It consists mainly of models, working exhibits, and demonstrations, designed and displayed in such a way that some portion of the exhibition cannot fail to interest all visitors, whether technical or non-technical. The Science Museum is open to the public free of charge on week-days and on Sunday afternoons.

The exhibition, which was opened by Sir Alfred Ewing, K.C.B., F.R.S., is the outcome of a suggestion of the late Sir William Hardy, F.R.S., who, but for his untimely death, would have presided this year at the meeting of the British Association. The exhibits have been supplied by the manufacturers and users of refrigerating machinery, and the Museum has had the wholehearted co-operation of the British Association of Refrigeration, the National Physical Laboratory, and the Low-Temperature Research Station. The arrangements have been in charge of Mr. T. C. Crawhall, M.Sc., an Officer of the Museum.

National Physical Laboratory Exhibits.

The work carried out at the National Physical Laboratory on problems affecting the refrigeration industry is illustrated by several exhibits. The apparatus used for measuring the heat transmission through insulating materials is exhibited. In this an electrically-heated plate is placed between two layers of the material under test, the whole being sandwiched between two cold plates.

A typical series of materials used for insulation purposes is shown, the thicknesses of the various specimens having been adjusted so that all specimens have the same insulating value. It is interesting to note that a layer of 1-in. cork would afford the same insulation as a wall of solid oak 4-in. in thickness.

Other exhibits are instruments for testing the atmosphere in a cold chamber. The water vapour content is determined by a hygrometer which utilizes thermojunctions instead of thermometers of the usual type. Through this means the instrument is made distant reading and of great sensitivity.

A cinematograph film is shown of the various other researches in progress at the National Physical Laboratory, such as those concerned with the flow of air through ducts, and evaporation from wet surfaces. The greater part of this work is undertaken on behalf of the Food Investigation Board of the Department of Scientific and Industrial Research. Investigations and tests are also carried out as required for commercial firms and other bodies.

A small handbook has been prepared and will be on sale at the price of 6d. (by post 7d.); copies may also be obtained from H.M. Stationery Office. In addition, a Bibliography on Refrigeration has been prepared in the Science Museum Library and will also be on sale.

Gas-Driven Vehicles

Discussion at a Meeting of the Institute of Fuel

Speaking at an informal meeting of the Institute of Fuel, held at St. Ermin's Hotel, Westminster, London, S.W. 1, on Friday, April 20, when the subject of alternative fuels for road vehicles was discussed by their protagonists,

Dr. C. M. WALTER (of the Birmingham Corporation Gas Department) said that the crux of the problem of extending the use of road vehicles operating on town gas carried in high-pressure cylinders was the provision of the necessary filling stations. He did not discuss fully the economics of the problem of running vehicles on gas, because the Special Committee which had been formed, representative of the undertakings who were carrying out experimental work, would shortly be able to report its findings.

In discussing the experimental work, and particularly that carried out at Birmingham, he said that those concerned with this work had been able to satisfy themselves on two main points. In the first place, they had no difficulty in running a modified petrol engine on gas in such a manner as to obtain a higher thermal efficiency than when the engine was running on petrol; in other words, on the B.Th.U. basis, one could obtain better power output with a modified engine when running on town gas than when running on liquid fuel. There was evidence that, apart from the reduction in cost of fuel on the thermal basis, the use of gas for this purpose would result in further savings, particularly from the point of view of maintenance costs, because, owing to the volatiles having been removed through the compression of the gas, the constituents which would cause dilution of the lubricating oil had been removed. Indeed, in practice the effect was the reverse of dilution, for there was a gradual thickening of the oil due to the lighter ends of the lubricating oil being evaporated. So that not only had the problem of crank case dilution been overcome, but actually one had to use a lighter oil by reason of the thickening.

ECONOMICS OF GAS TRACTION.

In considering the economics of a gas traction scheme one must bear in mind the capital charges in connection with gas compressing and storage plant and the vehicle equipment, and the fact that no gas traction scheme could possibly operate until filling stations were installed in certain important centres. Figures published up to the present time were based on the prices of certain plant and equipment which had been made only in very small quantities—items such as storage cylinders and vehicle cylinders—and such prices might bear little relationship to the actual prices if a scheme were in operation.

There must be a number of vehicles in operation to justify the establishment of the compressing plant, and the plant would probably have to be working 10 hours a day in order to justify the considerable capital charges involved. So that some of the reports which had appeared from time to time, suggesting that they were very near the time when any vehicle could be changed over to gas operation, were quite contrary to what was really in mind at present. The Industry must have encouragement and stimulus in connection with the establishment of filling stations before the gas vehicle could develop rapidly; it had taken years for filling stations to be established in connection with motor spirit, and obviously it must be a considerable time before they could expect to see large compressing stations established for the re-fuelling of gas-operated vehicles.

The fuel cost was not the prime cost in connection with gas-operated vehicles. The cost of compressing town gas would amount at present to something like 1s. to 1s. 6d. per 1,000 c.ft.—compressed and delivered into cylinders at 3,000 lbs. per sq. in. Storage cost was also a considerable item of the total costs. Assuming the cost of the gas as 4d. per therm, that compared with about 5·2d. per equivalent gallon of petrol. At Birmingham, where motor buses were running 10 hours a day and covering from 110 to 120 miles per day, when using compressed gas at approximately 2s. 6d. per 1,000 c.ft. a definite saving could be shown as against the use of petrol; and as the mileage per annum was increased, the saving was increased proportionately. For a 32-seater 'bus, the saving amounted to from 9s. to 10s. per day under average running conditions. On the other hand, in the case of a van, although a very big saving could be shown on the fuel, that particular vehicle did not operate over a sufficient mileage to justify the capital charges on its cylinders. Thus the problem of reducing the heavy capital charges on cylinders and other necessary fitments was important.

TAXATION HANDICAP.

Another handicap was the present method of taxation, levied on the unladen weight of the vehicle, which penalized the gas-propelled vehicle to a considerable extent. If a solid-tyred vehicle taxed at £66 per annum when operating on petrol were changed over to gas operation, the tax would be increased to £93—an increase of £27. A petrol-operated pneumatic-tyred petrol vehicle taxed at £50 would be taxed at £70 if converted to gas operation—an increase of £20. The effect of including the weight of cylinder and other fitments was to penalize the gas-propelled vehicle. Owing to the 10-ton maximum weight limit imposed on passenger-carrying vehicles, the extra weight of the cylinders on a gas-operated vehicle resulted in the loss of a certain number of seats. Thus, assistance in regard to taxation must be looked for before they could assume that the gas-operated vehicle could operate on all fours with the petrol-operated vehicle.

The added efficiency of the Diesel type of engine over the petrol engine was due largely to the high compression ratio and the particular cycle of working. With gas engines one could obtain the same efficiency as had been obtained with the oil engines, so that the cost of fuel was about the same when using gas in the fuel injection engine. He had figures showing that with a properly designed engine operating on the fuel injection principle with gas, it was quite possible to compete with the heavy oil engine, provided there were filling stations available to supply the fuel.

If concessions in the matter of taxation could be obtained in respect of oil produced from coal, they ought to expect to obtain concessions in respect of gas-operated vehicles.

The cases for engines driven by petrol or heavy oil, and by steam, were dealt with at some length in the opening speeches, and the discussion ranged over a variety of types of engine. The portable producer was referred to as a device which might have to be considered very seriously, particularly if it could be made really small.

With regard to the costs of distribution of gas as a fuel for vehicles, one speaker emphasized that this would be considerable, for thousands of cylinders would have to be provided; and a factor to be borne in mind in this connection was that of the extraordinary conditions imposed by the Home Office to ensure safety.

It was inevitable that in a discussion such as this considerable emphasis should be laid upon the importance of developing vehicles which would make use of some form of home-produced fuel—though the protagonists of the oil industry, naturally, pointed to the very large revenue which this country derived from the taxation of petrol and oil. And it was also pointed out that, of the 1s. 5d. per gallon received for petrol when sold retail, 8d. represented tax, and 6d. represented costs of distribution in this country, the remaining 3d. representing the c.i.f. cost of the petrol. Further, that 3d. remunerated British capital invested abroad, British chemists, engineers, geologists, tanker crews, dock hands, &c. However, it was argued that the capital which would be required to replace 100 million gallons of petrol by gas for driving vehicles was not so formidable as some might imagine. The equivalent amount of gas needed for that purpose would be something like 25,000 million c.ft., on the basis of the present efficiency obtained—and the efficiency would be increased when engines were designed specifically for the use of gas. The coal required to produce the gas would be about $1\frac{3}{4}$ million tons, therefore, and this would yield also about 1 million tons of coke. The value of the equipment necessary for the vehicles would be in the neighbourhood of £2,000,000, and 4,700 tons of alloy steel bottles would be required. The compressing plant would cost about £4,000,000, and there would be a demand for something like 230 million units of electricity for driving the compressors. Thus, employment would be found for many industries. Again, if they disregarded patched-up engines and set out to design engines on the fuel injection principle for using gas, the thermal efficiency would increase, and in the engine using gas they would have all the advantages of the Diesel engine, *plus* the extra advantage that the fuel could be burned completely. Further, there was no crank case dilution, and the maintenance costs over a period must be very materially reduced.

A reference was made to the marketing in Germany of large quantities of propane, in bottles, the propane being extracted from brown coal by hydrogenation, and it was suggested that the time was not far distant when we might be faced with such a production of a gas in this country. The gas companies were producing liquid fuels, such as alcohols, &c., and all these various interests would come together to produce a common fuel suitable for the con-

sumer. In reply to this it was pointed out that in the oil industry in this country there were vast amounts of propane, butane, &c., which could be used, and emphasis was laid upon the possibilities of converting the lower hydrocarbons into material within the ordinary internal combustion range.

In a further reference to the national aspects of the fuel problem it was urged that it was not necessarily a matter of revenue from the taxation on oil, but also of the conservation of natural fuel resources. This led to a comparison between the efficiency of electrical and gas traction. It was pointed out that a really good efficiency for the conversion of coal to electricity was 20%, the efficiency of a storage battery was about 60%, and the efficiency of the motor driving the vehicle was probably about 80%, and ultimately only about 10½% of the heat in the coal was converted to use in the vehicle. The gas traction story was better than that, however, provided the capital costs and maintenance costs, &c., did not outweigh the improvement in efficiency in the use of gas as a fuel. Against that it was held that the cost of the coal used at the power stations usually ranged from 12s. to 15s. per ton, and that electric traction was not really uneconomic.

There were many present who considered that the further rapid development of the use of the Diesel engine for traction purposes was inevitable. At the same time it was emphasized that when the gas traction proposition had been developed a stage further and engines were designed specifically for using gas, the economics of gas as a substitute for some other fuels would be proved.

Annual Meeting of Gas Salesmen

There was a representative attendance of members from all parts of the country at the Annual Meeting of Gas Salesmen organized by the British Commercial Gas Association at the Caxton Hall, Westminster, S.W. 1, on Friday, April 20.

Mr. WILLIAM CASH, J.P., F.C.A. (Immediate Past-President of the Association), presided, and was supported on the platform by Mr. W. D. Rowe (Manager), Mr. J. C. Walker (General Secretary), and officials of the various District Circles.

In extending a hearty welcome to those present, Mr. Cash referred with regret to the unavoidable absence, as a result of a slight accident, of Sir Francis Goodenough, C.B.E., Executive Chairman, and asked permission to send a telegram of condolence. This was unanimously agreed to. Mr. Cash went on to say that the proper person to be occupying the chair on that occasion was Lt.-Col. H. K. Stephenson, the present President of the B.C.G.A., whose numerous engagements in Sheffield, however, prevented him from being there.

Continuing, Mr. Cash said they should all bear in mind at the present time that they were purveyors of fuel divided into three classes—namely, gaseous, solid, and to-day they were also extending into the liquid fuel field by the production of benzole. These three types were in turn split up into three further classes for utilization—namely, light, heat, and power—so that the salesman had to be equipped to deal with very varying problems. The training of the salesman for that reason was a much more serious and diversified matter than it was in the old days. Various points arose in regard to competition. There was the question of cost, and he suggested that the matter of cost was by no means the only point relating to the supply of gas. Even if it was higher than that of the products of their competitors, they had to consider the point of efficiency and what could be done with the use of the gas appliances they were trying to sell. Reliability was another point which the Gas Industry could usefully bring forward, while simplicity of operation should also be stressed. A most important point was that the salesman should not attempt to exaggerate the benefits and advantages of what he was trying to sell, and he must certainly be endowed with sincerity and a belief in the appliances he was selling.

SUPPORTED BY THE DIRECTORS.

Speaking as a Director of several large gas undertakings, Mr. Cash said that the salesmen had the full support of the Board, who relied upon them to make their undertakings successful. The salesman was in direct contact with the public, and consumers and potential consumers regarded him as the undertaking. The salesman could also do a great deal of good by reporting to his superiors his experiences in regard to the sales of particular appliances, what appliances to push, and in what directions the existing state of affairs could be improved.

"Never lose heart," said Mr. Cash, "even if the results of the particular methods you are adopting prove disappointing." He gave them an instance of progress made in one of his undertakings, reported during the last few days. A hotel which had gas fires in every bedroom extended its premises by the addition of some ten further rooms, in which they thought to be up-to-date by installing electric fires. After two months the proprietor had all these electric fires removed and replaced them with gas fires, having found that his clients much preferred gas. Again a study of the B.C.G.A. *Bulletin* would bring out many facts which would be encouraging to them, showing what was being done in other directions by many undertakings.

They would often read in newspaper reports of the enormous strides being made in the electrical industry—expressed in terms of percentages. Though as an accountant he should, perhaps, hesitate to say such a thing, figures could be made to prove almost anything; and in this connection he referred to a statement recently made in regard to the Bournemouth electrical undertaking to the effect that the number of houses wired for electricity only had increased by 100% over the previous year's figures. In actual fact the number of houses so equipped in each year were one and two respectively!

EILEEN MURPHY.

The recipient of the Goodenough Gold Medal for the best paper read before a Salesmen's Circle during the 1933-34 Session.

He was very much encouraged by the reports of their undertakings in respect of sales through the showrooms. In all the companies with which he was concerned in this country such sales were very much ahead of the previous year's figures—partly due to the attractive showrooms they were building and partly to the increased efforts of the salesmen. He still thought—and he was sure that leaders of the Industry would agree—that, given a fair field, there was nothing to fear in the Gas Industry to-day. In conclusion, he again expressed his thanks to the salesmen in the Industry for all the good work they were doing, backed up by the operations of the B.C.G.A.

PRESENTATION OF GOODENOUGH GOLD MEDAL.

The Goodenough Gold Medal, given for the best paper read before any of the Salesmen's Circles during the year,

was next presented by Mr. Cash, who regretted that Sir Francis was not there to present it in person. The recipient on this occasion was Mrs. E. Murphy (of the B.C.G.A.) for her paper before the Southern District (London Area) Circle, entitled "Women and Domestic Gas Sales." In handing over the Medal, Mr. Cash heartily congratulated Mrs. Murphy, who briefly returned thanks, remarking that if they were all as helpful to their women customers as they had always been to her, gas sales would never suffer.

Looking Ahead.

An address entitled "Looking Ahead" was then given by Mr. E. D. A. Herbert, M.A., Controller of Sales to Messrs. Wolsey, Ltd., of Leicester, who stressed that every real salesman, before attempting to sell, studied his market from every point of view—but particularly from that of the market itself, whether it be a whole country or only one single individual. There were, he said, Ministers of Mines, Ministers of Shipping, and Ministers of Agriculture in the Governments of the British Empire, and he confidently foresaw a time when the profession of selling would justify similar distinction at the hands of the Crown, not to speak of it taking its full share of responsibility at the Boards of industrial undertakings.

Proposing a hearty vote of thanks to Mr. Herbert for his remarks, Mr. W. D. Rowe said that they had heard a very illuminating address; a tremendous number of points had been raised, which would give them a great deal to think about for days to come. He was particularly glad that Mr. Herbert had spoken of "taking stock," because after a long period of industrial supremacy in this country they had to take stock—not only of their jobs, but of themselves. That was what was happening in the B.C.G.A. at the moment; they had got to bring their methods into conformity with modern ideas.

Mr. P. H. Christian (Southport), the Chairman of the Lancashire District Circle, seconded the vote of thanks, and associated himself with the remarks which had been made regarding the admirable address they had heard that morning. He also took the opportunity of saying how glad he was to see their respected friend, Mr. Walker, back in harness again. He knew he would be expressing the feelings of all the District Circles when he wished him a continuance of good health for many years to come. The address they had heard that day, he said in conclusion, would energize them to still further efforts on behalf of their undertakings.

More than a Vending Machine.

Mr. Cash, in supporting the vote of thanks, said that if the address went beyond their immediate individual outlook, it gave them many important things to think about which had a distinct bearing on the work in which they were engaged. The modern salesman must be a great deal more than a vending machine, and he hoped they would take to heart the point of finding the right thing for the customer and the most suitable appliance for his immediate needs. Mr. Herbert had mentioned the enormous capital outlay involved in the electrical grid, and it was the fact that electricity had got to be sold in large quantities to-day to pay the interest on this outlay that made competition so intense. They greatly appreciated the time and care Mr. Herbert must have put into the preparation of his address.

The vote of thanks was carried by acclamation, and, in acknowledgment, Mr. Herbert remarked that he considered it not a bad idea to look occasionally at other things. The trouble in modern life was that they were so close to their problems that they could not see anything else. They sometimes got too near their jobs to obtain a proper view; and for that reason he had dealt on that occasion with some of the problems of another trade.

This concluded the business of the meeting, and after lunch the members paid a visit to the Ideal Home Exhibition at Olympia, the Gas Industry exhibits at which were described fully in the "Journal" for April 11 last.

BOOK REVIEW

APPLIED CHEMISTRY.*

The Annual Reports of the Society of Chemical Industry on the Progress of Applied Chemistry are always welcome, and the volume for 1933 is no exception. The Reports are particularly useful as an exceedingly well compiled bibliography of recent events in and contributions to the development of applied chemistry, and the indexing is an excellent feature. As for the "story" itself for 1933, the various sections are in most capable hands, as formerly. The section General, Plant, and Machinery is this year written by R. E. V. Hampson and J. N. Vowler, who devote a good deal of attention to the important question of water conditioning in boiler practice. The contributors of the section on Fuel are H. J. Hodsman, E. Spivey, G. Milner, and T. H. Blakeley, of the Fuel Department at Leeds University, and what we have said about the value of the references is specially applicable in this case. We may mention that no fewer than 141 references are given and that some of these references contain as many as eight sources of information. On the question of hydrogenation of coal the authors state that from an economic point of view, production of oil by this process, so long as oil is abundant and cheap, "is doubtful wisdom, although this is not properly understood. Its effect on the coal trade has been exaggerated. . . . As things are, however, it is unlikely that a coal country like Great Britain without indigenous oil supplies will allow itself to be deprived of the knowledge and experience of the technique of obtaining oil from coal, even at some cost." In regard to domestic heating they observe quite rightly that probably the most important problem is the future fuel for the open grate, and they equally rightly question the wisdom of the efforts of the Coal Utilization Council to increase the use of raw coal for this purpose. The following statement is of interest: "The conclusion that any fuel acceptable for the open grate will be a light one implies further that its distribution can occupy at least everyone now engaged in distributing the coal it will replace. The realization of this by the coal trade might mitigate the reactionary tendency to encourage the use of raw coal."

"Gas, Destructive Distillation, Tar, and Tar Products" is in the hands of G. E. Foxwell, who commences the section by reviewing the recent work of the coke oven interests in producing a coke suitable for the open firegrate. Mention is made of the fact that coke ovens of a new design are being built for the specific purpose of making open-grate coke. Dr. Foxwell's contribution shows what strides are being made in gas-works practice, though recent work on complete gasification does not receive comment. The section on Refractories, Ceramics, and Cement is by T. R. Lynam and W. J. Rees. One of the noteworthy features of the section is the progress made in methods of testing refractory materials. The remaining section of direct interest to our readers—Acids, Alkalis, Salts, &c.—is written by J. W. Parkes, who refers to the new Fauser process for the manufacture of ammonium sulphate and other ammonia fertilizers. In this process sulphuric acid mist is introduced into the top of a chamber while anhydrous ammonia gas enters through apertures on the bottom. This counter-current method ensures that the falling acid mist encounters a medium that becomes increasingly alkaline. Hence the salt produced is completely neutral. The concentration of the sulphuric acid used is so regulated that the heat evolved on neutralization suffices to evaporate all the water of the sulphuric acid. The resulting salt falls on to the floor of the chamber, passes through a number of openings, and is taken up and transported by a screw conveyor. A regulated quantity of water is added to the salt while it is on the conveyor, owing to the peculiar construction of which the micro-crystals are converted *in situ* into small round spheres which after drying in a rotary dryer do not harden or cohere during storage.

The 1933 volume of the Annual Reports consists of 770 pages of text, of which the index occupies 60 pages.

* Annual Reports of the Society of Chemical Industry on the Progress of Applied Chemistry, 1933, Vol. XVIII. Published by the Society of Chemical Industry, Central House, 46-47, Finsbury Square, E.C. 2. Price, to members of the Society, 7s. 6d. prepaid; non-members, 12s. 6d.

Factors Influencing Carbonizing Results in Vertical Retort Practice*

Recent Experiences at Birmingham

By F. H. Bate, B.Sc., Assoc.Inst.Gas E., and A. R. Myhill, A.I.C.

Any adjustment in the pull or pressure at the offtakes of the retorts is followed by an immediate response, beneficial or otherwise, to the carbonizing results.

The evils of over-pulling, with consequent increased inerts are, of course, well known, but it is probably imperfectly realized to what fine limits proper adjustments should be carried out. It is easy to calculate the increased thermal yields which can be obtained by elimination of inerts and the addition of water gas, but it is not often that a demonstration can be carried out on a large scale. The following figures give the results of two tests carried out on a very lean Derbyshire coal, using about 1,000 tons of coal for each test. The section was about 3 years old when these tests were carried out.

Table 1.

—	First Test. With 9/100 In. Pull in Foul Main and Slight Pull on Retort Offtakes.	Second Test. With 3/100 In. Pull in Foul Main and Level Gauge on Retort Offtakes.
C.V.	462·8	462·4
Make per ton, c.ft.	15,138	16,187
Total inerts, %	11·9	9·7
Therms per ton	70·06	74·85
Steam pressure on steaming nozzles, lbs.	30	50

It can be seen that the primary adjustment was that of the pull. The C.V. and throughput remained constant. Steam alterations were made to a degree necessary for maintaining the C.V. at the same value in both tests.

Many engineers would, no doubt, consider that the 9/100 in. pull in the foul main, giving slight pull on the offtakes of the retorts, was very moderate, but a reduction of 6/100 in. in the pull gave an undoubted advantage.

It was considered inadvisable to give definite pressure conditions on the offtakes, as this made matters rather bad for the men. Nevertheless, experience has shown that, from the point of view of the gas yield, very slight pressure at the offtakes is preferable to even a shade of pull. There is always a temptation to adjust calorific value from time to time by varying the amount of pull. Our tests and experience have proved beyond doubt that this practice is extremely bad, from the points of view of both retort life and thermal yield.

When working to very fine shades of pull, various mechanical or physical difficulties arise. If a sensitive recorder is connected to the foul main and the pull kept constant, it will be found that the recorder will give different readings if its position is altered. The pull reading indicated will increase or decrease as the recorder is lowered or raised. The resistance of the mains to gas flow will also affect the readings.

It is difficult to insist upon certain theoretical conditions being maintained on the offtakes because of the difficulties in measuring those conditions. It is better to fix the recorder in a convenient position, adjust the pull until a satisfactory nitrogen figure is obtained, and then maintain the recorders at that reading. The recorders at Windsor Street are fixed at conditions which give less than 4% N in the crude gas.

There are 24 Arca regulators fixed at Windsor Street, the workings of each one being registered by an appropriate recorder.

Throughput Per Retort Per Day.

A little consideration will show that the highest make per ton need not, by itself, constitute the best carbonizing practice. The ideal to aim at is the cheapest possible therm, and this is dependent to a very great extent on the maximum amount of coal which can be properly carbonized per retort.

Many people have even advocated sacrificing a small proportion of the make per ton in favour of a high output per retort.

Our experience with high throughputs has been that the make per ton has not suffered; on the other hand, an increase of about 20% above the nominal throughput has resulted in the make per ton being well maintained. It is obvious that maximum throughputs can only be obtained with settings equipped with producers amply capable of providing the necessary quantities of heat at a sufficiently high rate. This is now being fully recognized in modern retort house design.

In the past we have been unfortunate at Windsor Street in being short of producer capacity, as reconstruction has taken place within the limits of the original settings designed for non-steaming conditions. In more recent years, however, regeneration of secondary air has largely been cut out, with corresponding increase in grate area within the same space. It has been found better to utilize any waste heat for steam production rather than for preheating the secondary air. With the improved heating facilities thus provided, we have been able substantially to increase our throughputs.

It has been our policy to work every retort at its maximum throughput. When dealing with entirely re-constructed ranges, which showed the greatest increases of grate area, some striking results were revealed. The following table gives two typical tests from the ranges of 76-in. retorts:

Table 2.

—	Tests on a Very Lean Derbyshire Coal.	Tests on a Lean Yorkshire Coal.
Tons of coal carbonized	2,087	777
Make per ton, c.ft.	16,056	17,137
C.V.	475·9	490·0
Therms per ton	76·41	83·90
Nominal throughput, tons	7·6	7·6
Actual ,, ,,	9·12	8·81
Throughput over nominal, %	20·0	11·6
Average temperature of combustion chambers, ° C.	1,380	1,335
Average temperature of check tiles, ° C.	1,112	1,027
% steaming	21·6	22·6

The high throughputs in the above test are not freak figures. They have occasionally risen as high as 10 tons per day and are being maintained.

Increase in coal carbonized per retort immediately results in the following advantages:

A. *Proportionately Lower Labour Charges.*—This is self-explanatory.

B. *Decreased Percentage of Inerts with a Consequent Increase in Thermal Yield.*—The volume of gas evolved per retort will show an increase, while the volume of inert will remain approximately constant. This will result in a decreased percentage of inerts.

C. *Lower Fuel Costs.*—The heat losses of the setting, radiation, and convection will remain constant whatever the throughput. Hence, if the throughput be increased by 20%, it is not necessary to increase the supply of fuel by 20%, but by something substantially less than that amount.

To give an actual experience, based on 2 years' working at Windsor Street, one year at nominal throughputs and the following year at high throughputs, it was possible to increase the amount of coal carbonized on the works by 12,300 tons with a decrease in fuel to producers of 1,300 tons.

The explanation is that a decreased number of retorts were at work in the second year to carbonize more coal, and the settings were correspondingly more efficient from a thermal balance point of view.

The average throughput of our 57-in. retorts is now between 6·0 and 6·3 tons per day and that of our 62-in. retorts 6·7 to 7·3, while our 76-in. retorts carbonize 9 to 10 tons, depending on the type of coal used. It will be seen that these figures are considerably in excess of the standard of 1 ton per 10-in. major axis normally taken as the capacity for W-D continuous verticals.

D. *Increased Thermal Yield.*—Our experience at Windsor Street has been that increased throughputs have been followed by increased thermal yield not only per retort, but also per ton of coal. This increase can be partially accounted for by the decrease in inerts already described, together with a further reduction in the inerts intaken at the bottom castings as a result of the heavier steaming and higher bottom gas pressures. The remainder of the increase is probably explained by the processes described by our President in his Presidential Address—see "Journal" for Oct. 18, 1933, p. 214. A lower coal "V" is produced by the increased throughput and a much larger volume of the

* From a paper before the Midland Junior Gas Association, April 12, 1934.

products has to pass through the red hot coke at the sides of the charge before they can reach the offtake. These circumstances would result in beneficial cracking of the primary distillation products which would otherwise pass in a larger measure into the tar.

The following pair of tests, which were carried out at our Coal Test Works at Nechells, show the increase in therms per ton which may be obtained by an increased throughput:

TABLE 3.

[Coal Carbonized – Nottinghamshire.]

—	Test No. 1.	Test No. 2.
Throughputs, tons per day	5·02	6·05
% steaming	5·0	8·1
Calorific value	475	477
Make per ton	15,652	16,274
Therms per ton	74·3	77·6
Temperatures of combustion chambers, °C.	1,365	1,375
Inerts, %	12·2	11·4

E. *Lower Capital and Repair Charges.*—The lower capital charges need no explanation. Lower repair charges are proportionate to the increase in the throughputs, coupled with a decrease in spalling of the silica. We have evidence of this decreased spalling on two separate ranges. High throughputs make for easier and more regular working, and in these circumstances the silica does not experience the same heat-racking as with irregular working. When a retort is working too slowly, blistering of the scurf occurs, and this causes the retort to halt and "hang-up." The silica attains a higher temperature than usual, and when the retort is put to work again it receives an excessive charge of cold coal. These conditions produce what has been termed "heat racking" of the silica and is conducive to the spalling revealed during the scaling.

F. *Better Coke.*—Quick travel of charge through a retort tends to produce a coke of more open texture than the corresponding coke from a slow coal travel. Further, the coke has not been "baked" for such a long period as would have been the case with slow coal travel.

Enough has probably been said to make out a very strong case for maximum throughputs, but, of course, it is not always an easy matter to achieve any increase.

If sufficient reserve, in the way of producer area, has not been provided, then the matter is hopeless, but in a simple case the following recommendations will probably be useful:

(*a*) The best possible grade of fuel can be used in the producer.

Generally speaking, the advantage gained will outweigh the extra cost. (These remarks do not, of course, apply to producers specifically designed to consume low-grade fuel.)

(*b*) Every effort should be made to secure the best possible distribution of heat in the combustion chambers.

Many engineers impose restrictions on the maximum temperature to be attained in the combustion chambers with a view to prolonging the life of the setting. This is a very sound policy, but it is still possible to secure a greater supply of heat and yet remain within the temperature restrictions by making full use of the auxiliary secondary air if any is provided, or, in an upwardly heated installation, by altering the size or shape of the nostrils.

(*c*) Care should be taken to keep all retorts at their proper speed.

If any retorts in a bench are laggards, due to any mechanical defects in the extractor gear, these should be quickly attended to and brought to their proper speed. It has always been our custom regularly to time extractor speeds. Further, if the coke contains more than 2% of volatile matter, or has a "smoky" effect during a discharge, the speed of the whole of that bench of retorts need not necessarily be reduced. The offending retorts should first be traced and the speed of these retorts reduced for 24 hours. This simple step will often cure the trouble.

A retort will often pass "smoky" coke not because the extractor is working too quickly, but because it is working irregularly, or because it is being supplied with quick travelling coal.

(*d*) *Selection of Coals.*—Some coals are notoriously difficult to carbonize, others relatively easy. In the term "carbonize" we may also include the capacity to steam down to the required C.V. with high throughput. If it is not possible to avoid the difficult coals, it is better to allocate them to certain retorts, arranging throughput to suit, and reserve the remaining coal for separate retorts, when improved average carbonizing results may be obtained.

(*e*) Examine the conditions prevailing during changes of shift.

Neglect often occurs during these periods, with a heavy reduction in gas make.

(*f*) Maintain constant supervision of steam services to retorts.

The steaming nozzles are particularly liable to have their capacity reduced by scale formation, which undoubtedly accumulates most during scurfing periods.

Unless this deposit of scale is removed, proper steaming cannot be maintained, and a restriction is placed upon output because the C.V. rises when any attempts are made to increase throughput.

(*g*) If necessary, increase the number of coke extractions per day.

At Windsor Street a substantial increase in gas made followed when the number of extractions per shift was increased from 4 to 5. If the throughput has been increased beyond the capacities of the original coke chambers, it follows that, at certain periods, after the chambers are full, the retorts cease to pass the charge. The engineer-in-charge would be well advised to experiment for himself in this direction. An examination of the coke chambers and the coal travel immediately before the first draw of every shift will often show up any shortcomings of this nature.

DEVICES FOR FACILITATING COAL TRAVEL IN TO THE RETORTS.

We have not experienced any major difficulties in the working of our retorts, with the exception of the range of 76-in. retorts. When this range was re-constructed in 1932, an attempt was made to reproduce certain features, which had been very successful elsewhere, in retort design. This introduced a major axis taper on the non-offtake side in the top 4 ft. of the brickwork. This taper resulted in the old top ironwork being slightly oversize. The taper proved unsuccessful, and various disadvantages connected with the top ironwork made the retorts very difficult to work. Even with the low swelling, easy travelling coal, constant rodding was necessary, and the retorts ran for short intervals only between scaling periods.

After certain experiments were made to improve the working of these retorts, our attention was directed by Messrs. Woodall-Duckham towards their special type of coal feed for insertion in the top casting.

A modification of this feed was designed for our particular installation. The two sketches show (1) the feed, and (2) the feed in position. It can be seen that, when the feed is in position, it is supported by two side plates. These are cast iron and bolted to the top casting, and remain in position during scurfing.

The feed itself, made of wrought-iron flats, is removed after the retort has been emptied ready for scurfing, and is replaced after scurfing is completed and the retort has been coked up ready for re-charging.

The construction of the feed in the wrought-iron flats was recommended as the most suitable design to withstand with the minimum distortion the temperature changes to which it is subjected.

It will be seen from the drawing that a gas passage exists at the front of the feed. It is necessary to provide an additional rodding hole in front of the scurfing cover to enable a tool to be introduced to keep this passage clear. The feed is wedged in position with the wedge shown and is still further secured by a bolt attached to the top of the feed and screwed through the retort casting. The introduction of these "trunk feeds" met with immediate success.

The feed is designed to deliver the coal, at a calculated rate of travel, into the carbonizing zone before the temperature of the retort has time to render the charge sticky with a tendency to block the feed.

Further, the gas passage offered by the feed prevents contact between the incoming coal and emergent gas, with resultant deposition of tar and pitch.

Very careful tests made on the test plant did not reveal any measurable thermal advantage as regards gas production, but the saving in labour amply justified their use. The length of time between scaling periods has been considerably increased since these feeds were put into use. Owing to the difficulties of working before the installation of the trunk feeds, it was only possible to run for an average of 18 days between scaling times. Since putting them into operation, however, this has been increased to an average of 28 days. One adverse effect of the feeds is slightly to reduce the throughput. The reduced throughput is still substantially over nominal.

One effect has been to increase the temperature of the gas leaving the offtakes. This reaches 300°-400° C. when using the feeds. The loss of heat from the settings must be made up by the consumption of a corresponding amount

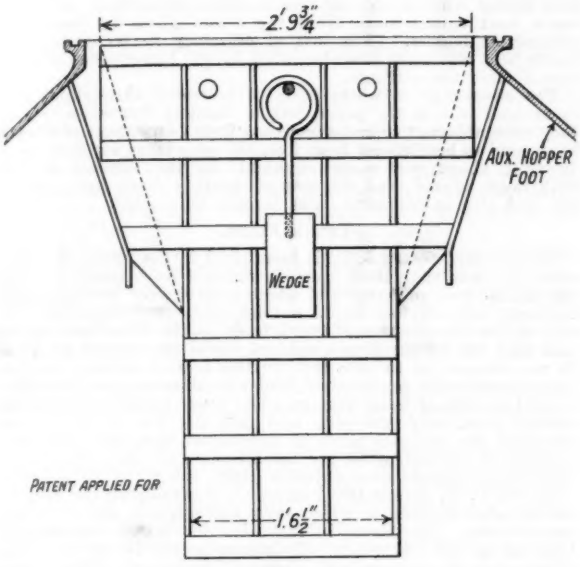


Fig. 1.

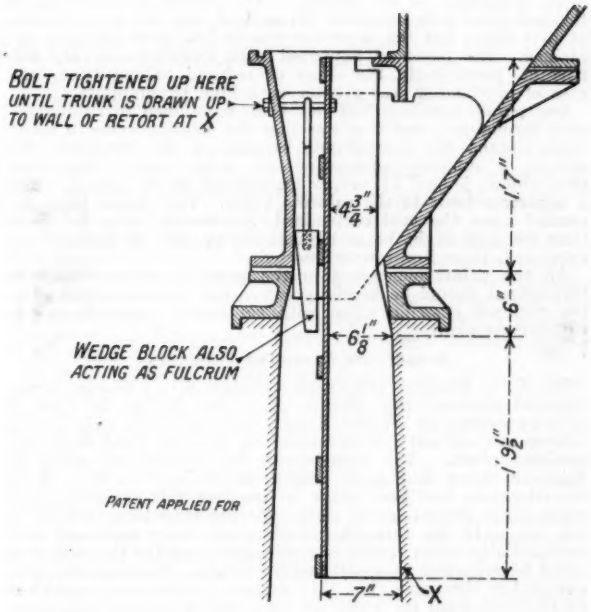


Fig. 2.

of extra fuel, and the characteristic trouble of this range to form an excessive amount of deposit in the offtakes, &c., would have been accentuated if means had not been provided to guard against this by the extra spraying of liquor in the mains and downtake pipes.

It is suggested that these feeds are well worth trying on difficult retorts, or when working troublesome coals or slack.

Upwardly Heated Retorts.

Members of our Association will have an opportunity, at Windsor Street, of inspecting one of the latest ranges of upwardly heated retorts.

The advantages claimed for these retorts are as follows:

(1) *Easier Coal Travel,* since the coal approaches the zone of maximum temperature more slowly than with the downwardly heated type, and there is less swelling in this zone. Consequent upon this is the improved capacity of upwardly heated retorts to deal with slacks or with highly swelling coals.

(2) *Longer Life.*—The zone of maximum temperature (and hence the silica construction) is at the lower part of the retort, not at the top. What would be the normal spalling zone in a downwardly heated retort is constructed of firebrick. Hence, spalling troubles are largely obviated.

(3) *Longer Periods between Scaling.*

(4) *Higher Thermal Yields.*—Carbonization is carried on lower down in the retort; hence, more cracking.

(5) *Increased Steaming Efficiency.* — Since carbon monoxide production is greatly accelerated with increase of temperature, it is reasonable to expect greater steaming efficiency with higher temperatures in the steaming zone.

The range at Windsor Street consists of 66 retorts, with a major axis of 62 in., and is heated by an external battery of step-grate producers specially designed to burn a large proportion of breeze and dust.

The lay-out of the top ironwork is very interesting. The gas collecting main is lowered to the level of the top of the setting and the offtake pipes slope downward from the retorts to the collecting main. This enables the offtake to be fitted with a liquor spray and almost entirely eliminates augering.

The charging stage is unusually wide and airy, and the absence of mains at lower levels allows splendid ventilation. A feature of this range is the ease of working of the retorts. The minimum amount of rodding is required, and starting up and shutting down at holiday times is very easy. During the Christmas shut-down last year, the range was re-started without any retort being rodded, every one of the 66 retorts starting on its own accord.

The fuel to producers is all below 1¼ in. in size and contains up to 25% below ⅜ in.

Difficulties have been experienced in the segregation of the dust, chiefly in the producer-hopper, and this is liable to give clinker trouble in the fires.

A certain proportion, probably 5-10% of the dust, travels through the fires, and appears in the ashes. When assessing the advantages to be gained by the consumption of dust, it is advisable to remember this fact, and that, furthermore, the cost of attention to the fires may be doubled.

Even allowing for these adverse factors, the consumption of dust shows a profit, about 50 tons of this material being consumed per week in these producers, releasing an equivalent quantity of good coke for sale.

The working temperatures of the setting are 1,350° C. at the bottom of the combustion chambers and just below 1,160° C. at the top.

It must be remembered that, in the case of an upwardly heated setting, the gases are travelling in their natural direction—*i.e.*, upwards—and that only about 3½ tenths of stack pull are needed to operate the setting. This sensitiveness renders it imperative that a safe margin should be maintained between the working temperatures and safe maximum temperatures. Further, as the fireclay zone extends to below the normal spalling zone, an excessive top temperature would imply that this material was being heated to a higher temperature than would be conducive to long life.

Briefly, the setting has achieved the advantages already described.

The following test relates to the carbonization of a Yorkshire nut coal on the range:

Table 4.

Tons of coal carbonized	716
C.V.	482·7
Make per ton, c.ft.	18,328
Therms per ton	88·47
Nominal throughput, tons	6·2
Actual throughput, tons	6·77
% steaming	26·0
Temperatures—Bottoms	1,360° C.
,, —Tops	1,150° C.

Discussion.

Mr. W. McNaughton (Wolverhampton), in proposing the vote of thanks, said he would be glad of information respecting the effect of the trunk feeds on benzole production, and mentioned the fact that trunk-feeds installed at Wolverhampton had increased the specific gravity of the benzole.

Mr. E. L. Wallis (Wolverhampton), in seconding the vote, asked Mr. Bate if he was in full agreement with the policy of reducing the regenerator construction. Was it a fact that colder secondary air increased the length of the flame, thus avoiding hot spots, and making possible an increase of heat supply in the combustion chambers?

The President (Mr. S. K. Hawthorn) said that no particular emphasis was laid on the magnitude of the retort house at Windsor Street, but when they consider that the retort house comprised about 270 retorts with capacities ranging from 6 to 10 tons each per day, and that any section making 3 million c.ft. per day could be completely isolated for test purposes and accurate carbonizing results obtained from one coal under absolutely normal working conditions, they must then realize the significance of what the paper contained.

The benefits which could accrue from working at maximum throughputs without exceeding safe working temperatures were to his mind among the most important points made.

Reduction of labour charges was of greater significance in large retort houses than in small ones because a small retort house could not always dispense with labour when shutting

down a portion of its retorts. The reason for increase of thermal yield with increased throughput was not very obvious at first sight, but the improved results had been logically explained. The point of improved coke quality was very important, particularly the effect of reduced baking time, and ease of ignitability was greater with high throughputs.

One point, however, had not been mentioned in connection with throughput, and that was that the calorific value in many cases limited the throughput, because of the necessity for making a sufficient proportion of water gas. Maximum throughput, judged by proper burning-off of the charge, fixed a minimum limit to the calorific value. That lower limit depended upon the coal carbonized, but would never be lower than 460 and might be as high as 510 or 520. If benzole was extracted, these limits were lowered.

All the points mentioned in the paper in connection with throughput should be carefully considered when deciding upon the declared calorific value with continuous verticals as the carbonizing plant.

Inadequate Producer Capacity.

Mr. G. C. Pearson (Engineer, Windsor Street Works, Birmingham) observed that Messrs. Bate and Myhill, in view of their experience at Windsor Street, were peculiarly able to give information on methods of improving thermal yield from carbonizing plant. For many years the carbonizing plant at Windsor Street had given indifferent thermal yield. Many investigations had been made to improve this condition, and while slight improvements were apparent from time to time, it was not until the throughputs of retorts were increased that substantially better results were obtained, and the thermal yield could be regarded as a satisfactory return. These points were outlined in the paper, but this increased throughput could not be obtained until the producer area was of sufficient capacity. The reason for the inadequacy of the producer capacity at Windsor Street for a number of years was to be found in a review of the history of Woodall-Duckham retorts at these works. The first installation of Woodall-Duckham retorts, consisting of two rows of 44 57-in. retorts, was laid down in 1912. The retorts had been regarded up to that time as 4½ tons per day, but Messrs. Woodall-Duckham guaranteed 5 tons per day to the new installation. For a number of years the throughput exceeded 5 tons, and very good carbonizing results were obtained under non-steaming conditions. The retorts were built of silica material, and in 1915 construction of four further rows of a similar type was commenced, being completed early in 1920. The whole of the six rows were constructed for non-steaming conditions, while before the installation was fully completed, following a policy agreed by the Birmingham Gas Committee, the illuminating power standard had been abandoned, and the gas that was well over 500 B.Th.U. was gradually reduced to a calorific value of 480.

The immediate effect of these alterations, coupled with the introduction of steaming to the retorts, was that the throughputs dropped from over 5 tons to the region of 4-4½ tons. In all subsequent re-building from time to time every effort was made to increase the producer capacity. It must be remembered that the re-built settings were necessarily confined to the old limits of the non-steaming retorts, in order to obviate the big expense that would have been entailed in going down to the foundations, and renewing the whole of the ironwork.

Upon the introduction of silica construction, however, it was found possible to reduce the width of the retort monolith, including the retort and combustion chamber. Following out a policy of Messrs. Woodall-Duckham in reducing the depth of the combustion chambers in this manner between 1912 and the present time, the width of the retort monolith had been reduced by 8 in., allowing an increase in the width of the producer of 16 in., and giving alteration in area as shown by the authors' paper. Even after the producers had become of greater area they did not realize the possibilities of increased throughputs until the inception of the Test Works in 1932. They were then able to experiment with one half section at a time in order to obtain the best carbonizing conditions, and the throughputs were increased from time to time, as outlined in the paper, until they had reached the present high standard, while to their surprise the thermal yield was also brought up to a satisfactory figure.

It was interesting to consider that, should the grate area be calculated in terms of therms per retort, then the present area was actually smaller than that allowed in 1912.

Life of Setting.

The life of the setting did not appear to have been reduced, but he would like to make a point that, when considering the life of a retort setting, this should be adjudicated in terms of tons of coal carbonized, and not in days, as this was, of course, the criterion of the work done.

There was no doubt that the credit for the improvement was largely due to the initiative and technical ability of Mr. Bate, and the expert control of the Test Works by Mr. Myhill.

The influence of regenerators arranged in connection with retort settings was very serious. There was no doubt that the most economical way of conserving heat in waste gases from retort settings was by the regeneration of the secondary air supply. Unfortunately, however, the regenerators were necessarily complicated brickwork passages, and deterioration was likely to set up, causing leakage. It was therefore apparent that deterioration of regenerators could cripple a setting from the point of view of heat before the useful life of the setting was anything like completed. Their policy at Windsor Street, in view of that trouble, had been to increase bracing, and simplify the regenerators in the settings from time to time since 1912 until they had now come to the conclusion that the best policy was to cut out regeneration altogether, and rely upon heat conservation from the waste gases by means of waste-heat boilers. The loss of efficiency in recovering the waste heat was more than balanced by the better efficiency obtained from the settings.

The advantage in works costs of increased throughput had been dealt with in the paper, but he thought that when he said they were able now to make more gas from four ranges of retorts than used to be the case from five, the very large economy thus brought about was more apparent, as the expense of the fifth range ceased, and the cost of shutting down and starting up, and also maintenance, was largely eliminated.

Trunk Feeds.

With regard to trunk feeds mentioned in the paper, he must make it clear that these were introduced on account of difficult mechanical working, and where retorts were working satisfactorily such devices would not be used. The immediate result of the introduction of trunk feeds on the 7-ton installation was that the labour then employed could be reduced by 25%. It was interesting to note that on this section offtake arrangements were to be constructed similar to those on the upwardly-heated section of 6-ton retorts. The pipes on this section had always been very stubborn and difficult, but in the reconstruction the arduous work in connection with the pipes was entirely eliminated, while the amenities for the men were much improved in regard to ventilation, light, &c.

Mr. T. F. E. Rhead (Birmingham) congratulated the authors on the able manner in which they had applied science to gas manufacture. Mr. Bate, in his drive for higher throughput, had taken full advantage of improvement in grate area, elimination of recuperators, stronger bracing of settings, &c., and reaped the many advantages attendant on such procedure. A vital factor in this work had been the test plant. It would be useful sometimes to discuss the various practical, economic, and theoretical factors which prevented throughput being pushed still higher. Such discussion would be helpful in design of producers, flues, retorts, ironwork, &c. Increased producer gas gave a large quantity of heat, a longer usefully heated zone, and better heat transference.

A Unique Position.

Mr. T. Campbell Finlayson (Woodall-Duckham Company) drew attention to the unique position which the Windsor Street plant held in the development of the continuous vertical retort process. At the present time this plant held two world records as far as he was able to gather. It was the largest continuous vertical retort house expressed in terms of daily carbonizing capacity, and, in addition, the Windsor Street plant, since its inception in 1912, had carbonized more coal than any other vertical retort installation in the world. Dealing with the improvements in retort throughput which had followed the reduction of recuperator area and increase in producer grate area, he suggested that this was probably accounted for by the deeper band of high temperature in the combustion flues. Short sharp flame conditions were misleading as a measure of carbonizing capacity. With reference to the figures given by the authors on heat consumption in the setting, Mr. Finlayson suggested that the figures published by Mr. Hardie in 1926 were more representative of the fuel balance of a modern large plant than were the Fuel Research Board figures quoted by the authors. In connection with the question of breeze burning in step-grate producers, he suggested that the saving in fuel cost would be found to be considerably greater than the cost of extra labour. As regards segregation of coke and breeze in the producer storage hoppers, the best way to prevent this was to store the coke and breeze separately, to feed the coke and breeze into separate compartments of the producer skip, and thus to localize any segregation within the producer itself.

Mr. H. Kerr (Woodall-Duckham Company) said that a feature of the recent reconstruction work at Windsor Street was the large increase in carbonizing capacity of the new ranges resulting from replacing a setting of four retorts each with its own producer and recuperator by six upwardly heated retorts, heated by producer gas from a battery of producers at ground level. This concentration had been effected while at the same time improving the working conditions. He wished to concur with the suggestion that what he termed volume of heat in the combustion chamber was of more importance than high temperatures persisting only for a short length of the combustion chamber. Mr. Kerr suggested that, while he agreed with the authors as to the need of adequate producer grate area, yet this could be overdone. Excessive grate area increased the labour cost, might actually spoil the quality of the producer gas, and involved additional unnecessary expenditure.

Others taking part in the discussion were Mr. H. Smith (Nechells), Mr. G. Harvey (Birmingham), Mr. A. V. Wainwright (Shrewsbury), Mr. R. N. Hateley, and Mr. S. Brockbank (Walsall).

Mr. Bate, in his reply, mentioned that since the paper had been written the annual figures had been prepared, and these showed an increase of approximately 600 c.ft. per ton over the previous year, thus emphasizing the benefits of the four factors stressed in the paper.

Mr. Myhill, in his reply, stressed the importance of symmetry in foul main design, and said that many small works could be run as test works.

The Gum Problem—Recent Developments*

By W. H. Fulweiler, Chemical Engineer, the United Gas Improvement Company, Philadelphia, Pa.

During the past year substantial progress has been made in the solution of some of the many phases of the gum problem. A satisfactory test for the determination of NO in gas has been developed and a very sensitive test has been worked out for the detection of vapour phase gum even in minute quantities. These two developments have enabled us to make much more rapid progress in the general study of the problem.

We find that vapour phase gum is not confined to coal gas or mixed gas plants, as water gas plants may produce very large quantities of vapour phase gum.

There is probably no safe lower limit for the amount of NO which may be in the gas leaving the plant. It should be completely removed for assurance against possible trouble.

Plant operation has shown that it is possible practically to eliminate NO from the gas by proper purifier manipulation.

These in brief are the more important results that have been obtained during the past year. We have, of course, continued our study on a great many of the details of the problem, but the constitution and the mechanism of the formation of the gum itself is still unsolved.

In addition to the purely chemical side of the investigation, a great deal of work has been carried on looking to a study of the factors involved in the actual stoppages in the distribution system.

The effect of ageing the gas on the formation of gum particles in the gas has been studied, and an incidental feature of this work has been the development of pilots which do not stop up.

NO tests have been made throughout a number of large plants, and we have given particular attention to the variation in the amount of NO from hour to hour. These results have been very interesting as indicating the difficulty of drawing conclusions from single tests.

The flywheel effect of the distribution system on the NO content of the gas has been investigated.

Determination of NO in Gas.

The study of the gum problem was difficult in the early years due to the fact that there was no accurate method for determining NO in the extremely low concentrations that occur in manufactured gas. We recognized this some three years ago when we definitely proved that NO was the cause of vapour phase gums, and we have been working steadily on the problem.

The great difficulty is that it would be desirable to determine NO to a precision of 0·1 gram per million c.ft., or, roughly, one part in 230,000,000. This approaches the delicacy of spectroscopic tests so that a great deal of care is required both in the technique and in the purity of the reagents.

The present test involves mixing a sample of the gas with an equal volume of oxygen, allowing the mixture to react for approximately one and one-half minutes, and then absorbing the NO_2 formed directly in Griess reagent.

It is not necessary at this time to go into all the details of the development work, but we may say that the different details of the test have been carefully investigated, especially the possible effect of constituents of the gas on the reagents.

A compact piece of apparatus has been developed which permits the test to be carried on with a maximum of convenience and accuracy.

The observed results obtained in the test must be multiplied by a correction factor to give the true content of NO in the gas. After spending some two years in attempting to develop a test which would be free from the necessity of using a correction factor, we were finally forced to the conclusion that complete recovery of the NO could hardly be expected, and the complications involved did not appear to warrant further work in this direction. The correction factor mentioned was determined by analyzing mixtures made up from pure NO with city gas.

It should be remembered that in making the test there are two reactions occurring which are working in opposite directions.

(1) The NO in the presence of oxygen is oxidized to NO_2. This reaction normally very slow is catalyzed by some of the constituents of the gas which very greatly increase the velocity of the reaction.

(2) The NO_2 thus formed reacts with constituents of the gas forming gums, thus decreasing the amount of NO_2 available for recovery.

Both of these reactions progress with time.

The problem then was to determine what time of contact gave the maximum recovery of NO_2, and, in addition, was least affected by varying concentrations of gum forming constituents in the gas. Experiments indicated that the optimum recovery was secured with a relatively short time of contact and that under these conditions different types of gas would yield the same correction factor.

Tests for high concentrations can be made within less than a half-hour, while lower concentrations may require two hours. In some respects this is an advantage, since the longer the test is run the more will it tend to indicate a mean result, as experience shows that in many cases there is quite a fluctuation from hour to hour in the NO content of the gas.

The test as at present operated requires a minimum of time and manipulation, but does require strict adherence to technique and purity of reagents.

The discovery that the NO-NO_2 reaction is catalyzed by constituents in the gas cleared up a number of difficulties regarding the determination of NO. According to the literature, the oxidation of NO to NO_2 at the low concentrations occurring in city gas should go very slowly, so that we could not account for the very rapid formation of gum particles observed in the gas nor for the relatively large recovery (30-40%) actually observed in our tests. These facts were also quite at variance with the very large multiplying factor suggested by Shuftan.

The discovery of the catalytic nature of the reaction afforded a ready explanation for the observed results. In connection with the Shuftan test the calibration was originally made with nitrogen, so that in the absence of a catalyst and in accordance with theory only a small percentage of the NO was oxidized to NO_2, thus giving rise to the large factor employed in this test.

When the test is actually operated on city gas, the catalyst is present, so that a much larger proportion of the NO is oxidized to NO_2, but due to the long mixing time some of this NO_2 reacts and forms gum. As a final result, however, the NO_2 actually recovered is many times higher than that observed in the original calibration in the absence of a catalyst. For example, in a sample of gas containing 12·5 grams of NO per million, the Shuftan test actually recovered 13·4% of the NO present, but would report 168 grams per million, or 13·5 times the correct amount.

In the development work to determine the optimum time of contact we determined the recovery of NO with different mixing times and checked the above percentage recovery quite closely. We can, therefore, quite definitely state that the Shuftan test results are quite valueless as indicating the actual content of NO in city gas.

Test for Identification of Vapour Phase Gum.

One of the important facts in attempting to determine the source of trouble in the distribution system is to decide whether the gum causing the stoppages is vapour phase gum, liquid phase gum, or a mixture of the two. In our early work, the differential solubility of the two gums in various solvents, notably acetone, benzole and caustic soda solution, was used. The test proposal by Wenzel [*Gas Age-Record*, Vol. 71, pp. 413 and 606 (1933)] in which the gum was decomposed by heat and the gases driven off tested by starch iodide paper, was not sufficiently sensitive to be used directly with the very small amount of gum present on Rutz needle valves.

One of our men working on this problem, C. W. Jordan, found that the use of filter paper saturated with Griess reagent for the starch iodide paper in the Wenzel test increased the sensitivity enormously, and it was quite easy to determine whether the gum on a Rutz lighter needle contained vapour phase gum. In fact, the test is sufficiently delicate to detect quantities of vapour phase gum that are not apparent to the eye. As, for example, in one plant that was investigated it was found that the cause of the stoppage was a mixture of vapour phase gum and liquid phase gum. Apparently, the vapour phase gum particles that formed in the high-pressure distribution system absorbed a coating of indene and styrene which polymerized and oxidized to liquid phase gum, and this coating entirely surrounded the kernel of the vapour phase gum. Such material was quite insoluble in caustic soda,

* Paper before the American Gas Association's Convention, 1933.

but if a needle containing it was first dipped in benzole which removed the liquid phase gum, and to the eye apparently removed the entire deposit, and was then tested with the Griess reagent it gave a distinct test for the small amount of vapour phase gum remaining.

In connection with the distinction between liquid phase gum and vapour phase gum there is apparently a very notable difference in the amount of gum present. If the stoppage is due to vapour phase gum the amount necessary to cause stoppage is always microscopic—say, of the order of 0·000020 to 0·000065 gram—while with liquid phase gums there seems to be present a relatively large amount of material—say, of the order of 0·1 gram or more.

A further confirmatory test of the presence of vapour phase gum is the development of a pyridine-like odour when the sample is heated with sodium hydroxide or calcium oxide.

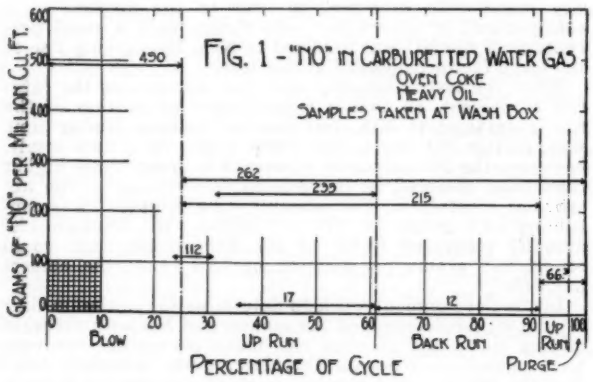
This test is not as sensitive as testing the gases evolved on heating with paper saturated with Griess reagent, but is a valuable confirmatory test.

Presence of Vapour Phase Gum in Water Gas.

Due to the inadequate test facilities available to us in the early part of our investigation and probably to the fact that our attention had been concentrated on plants distributing coke oven gas and mixed gas, it was our early belief that vapour phase gum was not important in plants distributing carburetted water gas alone.

During the past year this subject has been studied in greater detail, and it is found that not only does carburetted water gas nearly always contain some vapour phase gum, but that in at least one plant that was investigated the crude carburetted water gas contained more NO than the usual crude coke oven gas.

It would appear that there are two principal sources of NO in carburetted water gas. (1) The products of combustion which are high in NO and are not purged out at the beginning of the run, and (2) the combustion resulting from the infiltration of air during the make will yield very large quantities of NO. Fig. 1 is a curve showing some results observed at different points during the "run."



The NO content of carburetted water gas has been studied in several plants. As a result of more extended examination it would appear that the average content will in general be considerably higher than the figures quoted last year. On a number of occasions, tests showing only a few grams per million c.ft. have been observed, but in plants operating normally the amount will vary between 40 and 100 grams per million c.ft. with an average probably in the vicinity of 70 grams. Fortunately, however, the purifiers appear to remove the NO from carburetted water gas more rapidly and efficiently than they will remove NO from coke oven gas, and, in addition, there is generally a marked drop in the NO content in the storage holder.

This probably explains why the average carburetted water gas plant has not been troubled with vapour phase gum, but conditions may arise when its presence may result in serious stoppages.

Disappearance of NO in Storage Holders.

Many tests have been made on the effect of storage on the NO content of the gas. The results show that in general there is a decrease in the NO content. Under some conditions quite high concentrations of NO will disappear entirely in the holder within a few hours, while under other conditions relatively low concentrations will persist for many hours.

A series of tests on mixed gas in March, when the temperatures at the time of testing varied from 44° F. to 58° F., showed an average inlet content of 9·6 grams per million and an average outlet content of 4·0 grams. In July, when the temperature varied between 64° F. and 88° F., the average inlet was 4·0 grams, and 50% of the time the outlet was *nil* with an average of 0·3 gram. The calculated time of storage was about twice as great in August as in March.

The average amount of NO that disappeared was slightly higher in March than in August—*i.e.*, 5·6, as compared with 3·7—but we are primarily interested in the complete elimination of the NO, and this was approximated during the July series.

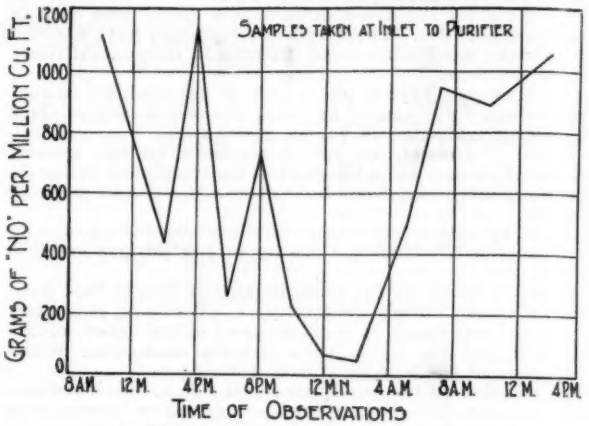


Fig. 2.—"NO" Content of Crude Coal Gas.

In the case of coke oven gas the same general results have been obtained; but we have recently observed in August the complete disappearance of as much as 65 grams per million of NO with a relatively short time of storage.

All that can be said at the present is that the rate of disappearance appears to vary with the temperature and oxygen content. Temperatures above 70° F. and oxygen content above 0·5% appear to favour the complete elimination of the NO in storage holders. This feature of the problem is being actively studied.

NO Should be Completely Removed.

In a paper a year ago it was stated, with some reservation, that if the NO at the outlet plant could be kept below 6 grams per million little trouble need be expected from gum stoppage. We are sorry to have to report that there now appears to be no safe lower limit for NO as even very small quantities down to below 2 grams per million will, if the gas is held in the distribution system for a sufficient length of time, form a sufficient amount of gum to cause pilot stoppages. Experience on a large scale has confirmed this.

In a large plant, for a number of months, the NO in the outlet gas averaged approximately 6 grams per million c.ft., and yet not only did the stoppages not decrease, but in some months they actually increased. With the change in the send-out during the summer, however, the purifiers could be rearranged so that during a month, on 13 days the outlet gas was free from NO and the average for the month was a little under 0·3 gram. A marked decrease in stoppages resulted.

In the laboratory the NO has been removed from the gas to different concentrations and the gas stored for different periods of time; the number of gum particles formed was observed and their effect on pilot stoppages determined. This has definitely shown that if all of the NO is removed, no gum particles will be formed, and, therefore, there will be no pilot stoppages due to vapour phase gum. If the amount of NO is low—say, 1 to 1·2 grams per million c.ft.—gum particles will form after 18 to 20 hours' storage, and these gum particles will stop up Rutz lighters in from 10 to 20 days. It must be understood, of course, that these conditions are very much more severe than would occur in an actual distribution system where the long horizontal runs of pipe both in the distribution main and the service pipe and the consumer's meter will all tend to remove some of the gum particles and thus reduce the tendency to stoppages. The experiments show, however, the potential possibility of trouble from gum stoppages with even very small amounts of NO and indicate the necessity for complete removal.

Removal of NO in Oxide of Iron Purifiers.

The process for the removal of NO, which we briefly mentioned last year and in our discussion two years ago, involves a modification of the operation of our present oxide of iron purifiers. We have disclosed the general out-

line of this process to several plants, and where the conditions permitted the operation in accordance with our theory the results have been very satisfactory. There has been a very marked reduction in the NO content of the gas. In addition to several of our own plants, two large coke ovens have been working on the process for some time with a marked reduction in the NO content of the pumped gas.

In some cases the plant connections and amount of oxide available make it difficult to carry out the process exactly in accordance with our ideas, and it undoubtedly requires considerable care and supervision in order to stabilize the conditions at their point of maximum efficiency.

There appears to be a very perceptible difference in the ease of removal of NO from water gas and from coke oven gas. One of our larger plants has been operating for some months on carburetted water gas removing practically all of the NO. When this gas was mixed with about an equal volume of coal gas containing considerable NO and the mixture passed through the distribution holder the outlet mixed gas going to the governor was over half the time entirely free from NO and has only infrequently exceeded 1 gram per million c.ft.

For plants that have available somewhat more than the normal amount of purification capacity our process would appear to give a practical solution of the gum problem.

With coke oven gas it appears to be more difficult to control the conditions, and the process itself does not seem to work quite as efficiently as with carburetted water gas. This is probably due in some measure to the presence of cyanogen compounds which reduce the efficiency of the oxide for the removal of NO. In plant operation it has been found difficult to maintain the NO much below 2 grams per million c.ft. for any considerable length of time; but in the semi-plant purifiers, where the conditions can be stabilized, very satisfactory removal of NO has been secured, thus demonstrating the correctness of our theory and indicating the necessity for close control to secure maximum removal.

A modification of the process that involves the removal of the oxygen from the gas has been operated on a semi-plant scale. This completely removes all the NO, so that with freedom from oxygen liquid phase gum formation would be largely prevented and corrosion practically eliminated.

At present the operating costs are high, but it is hoped that further experiments may result in decreasing them. Such a process would promise a final solution to both the vapour phase and liquid phase gum problems.

When the experiments indicate that even very small quantities of NO might, under certain circumstances, result in stoppages a great deal of attention was given in our Physical Laboratory to the development of pilots which would not stop up by the deposition of gum particles.

Constitution of Gum.

On the more theoretical side of the problem we have been continuing our work both on the constitution of gum and on the mechanism of formation. A detailed discussion of the chemistry involved would be out of place at this time, but we may say that the experiments indicate that the gum formed by the reaction of oxides of nitrogen with the various hydrocarbons and other compounds found in the gas is not a single compound but a mixture of various types of compounds, and it is this fact that rendered it difficult to interpret the early results. The compounds formed when the gum is decomposed either by the action of heat or alkalis have been investigated. There are four classes of compounds resulting from such decomposition.

(1) Gases, in which we have identified carbon dioxide, nitric oxide, nitrogen dioxide, nitrogen, ammonia, and low boiling amines.
(2) Hydrocarbons, in which we have identified indene.
(3) Organic bases, in which we have identified pyridine, iso quinoline, 7 methyl quinoline, and an amine of the penta methylene diamine type.
(4) Phenols, in which we have identified phenol, para cresol, and carvacol.

It would appear as a result of this work that poly carbocylic acids of pyridine-like bases are undoubtedly present in vapour phase gum.

The possibility of controlling the rate of formation of NO_2 from NO by the presence or absence of catalysts has given us a new method of studying the compounds present in the gas which react with the NO_2 to form gums. For example, with suitable conditions, we can, in the absence of gum-forming constituents, secure practically complete conversion of NO to NO_2 in a mixture of nitric oxide, oxygen, and catalyst in an inert gas. By adding to such a mixture the vapour of different compounds the reduction in amount of NO_2 recovered will be a measure of the extent to which the compound has reacted, under the experimental conditions. This new method of attack promises to yield very valuable information as to the mechanism of gum formation.

The X-ray diffraction pattern of various samples of actual gum and synthetic materials has been studied in the hope that this may be of assistance in determining their constitution. This work is continuing, and although it is of great academic interest, we do not believe that if we had the answer to-day it would assist us very greatly in solving the problem which, as we see it, is primarily the complete removal of the NO present in the gas.

Plant Surveys.

A number of long duration continuous tests have been made of the NO content of the gas at different points in the plant, and these show that, especially in the case of horizontal coal gas, there may be a very wide fluctuation in the NO content in the crude gas. This is reflected to some extent in the NO content of the purified gas.

These tests have also shown the rather wide variation that may exist from hour to hour in the NO and gum particle content of the gas going out from the plant. Some of these data are shown in figs. 3 and 4.

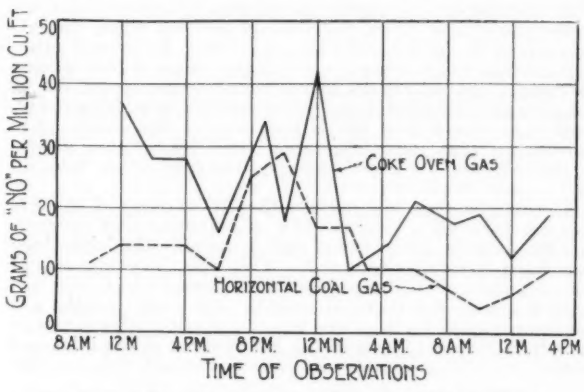


Fig. 3.—Variation of "NO" Content in Purified Coke Oven and Horizontal Coal Gas.

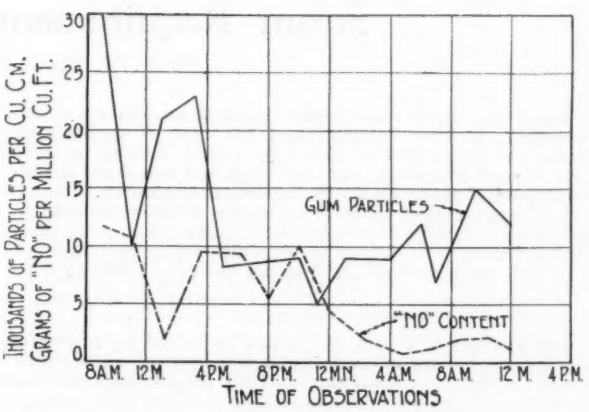


Fig. 4.—Hourly Variation of Gum Particles and "NO" in Mixed Gas at Works Governor.

It was evident that to secure more complete information NO tests should be run almost continuously throughout the 24 hours. Apparatus has been built to record continuously the NO content. The theory of the apparatus is relatively simple, but the requirements of the electrical devices used for recording the results are so strict that at present the apparatus may be quite expensive.

Removal of Gum Particles from the Gas.

In connection with the plant surveys there are cases where the NO entering the storage holder was fairly high, and yet all of the NO reacted in the holder so that the gas at the outlet while free from NO contained a large number of gum particles that would cause pilot stoppages. Such a gas would continue to cause stoppage until the existing gum particles were removed by settlement, &c. It is possible, of course, to remove a large proportion of the particles by steaming the gas in which case the steam condenses on the particles and carries them down and out in the drips. This process, while it is fairly effective, might

not be applicable, for example, to district governors where steam may not be available and does involve certain expenditures for steam, attendance, and the consequent drip pumping. In addition, tests have shown the water to be distinctly acid with the possibility of corrosion of the mains.

A very simple apparatus has been developed which is entirely self-contained and which will remove from 80 to 85% of the gum particles present. Tests on this apparatus indicate that pilots on the outlet will burn many times longer than pilots on the inlet, and it is believed that there may be situations where the use of such a simple apparatus, which is quite self-contained and would operate without attention over long periods, may prove of great assistance in the gum problem.

We propose to develop this apparatus more fully and test it out on a relatively large scale in practice, as its use may be found simpler and more convenient than the use of steam.

Effect of Distribution System on NO Content.

We have previously pointed out that the distribution system was a factor in modifying the effect of the NO in the gas. For example, it has been the general experience that trouble due to vapour phase gum stoppages does not immediately appear in distribution systems when the NO content of the gas is suddenly increased. In several situations it has taken from a year to two years before serious stoppages due to vapour phase gum became apparent. A number of surveys of distribution systems have been made, and have shown that the NO content of the gas is quite erratic, in that depending upon conditions whose nature is still obscure the distribution system may either take up NO or give it off.

During the past few months the NO content of the gas passing through a short section of sampling line connecting the meter room in one of our plants with the laboratory has been carefully followed. This line is composed of varying sizes of steel pipe from 2 in. down to ½ in. and was a little under 800 ft. total length. For some months gas has been passed through this line at a nearly uniform rate of 35 c.ft. per hour. Tests of the NO content at the inlet and outlet show that at times in passing through this line the gas at the outlet would be 8·0 grams per million higher than at the inlet, while at other times it would be as much as 10·0 grams per million lower than at the inlet. There appeared to be some correlation with changes in temperature, but this was not very clear.

It required some four days after the NO content at the inlet of the line had been reduced to zero for the gas at the outlet of this line to reach zero.

These changes are somewhat smaller in magnitude than have been observed in an actual distribution system where differences between the NO content of the gas at the plant, and the NO content of the gas at points in the distribution system has varied as much as 12 grams per million c.ft. during a few hours.

At times of minimum consumption the NO in the gas in the system was generally lower than that leaving the works, while at times of peak load the gas in the system at times contained 10 to 12 grams per million more NO than at the works.

The mains seemed to act to some extent as a flywheel absorbing NO under certain conditions and giving it off again under other conditions. A series of tests made in a large distribution system showed that after the NO was eliminated from the gas going out of the plant two weeks elapsed before the NO was reduced to a trace at a point five miles from the plant.

It is evident that a considerable period must elapse from the time the NO content at the plant is reduced to zero before we can expect a total cessation of stoppages due to vapour phase gum.

Two possible explanations are suggested for this phenomenon. One would involve the formation of a very unstable iron NO sulphur complex in the mains, while the other would suggest that NO is dissolved in the thin film of naphthalene and condensate that we believe always exists on the interior of the distribution mains and is given off again with an increase in temperature.

Laboratory experiments have shown that NO is quite soluble in naphthalene and in tar oils, and that the solubility decreases rapidly at higher temperatures.

The advance made during the past year encourages us to hope that at the present rate of progress another year's work will furnish solutions for all the more important features of the gum problem.

Steam Requirements on a Gas-Works*

By F. M. Birks, O.B.E., M.I.Mech.E.

The gross steam requirements of a gas-works vary considerably, as they depend upon the type of carbonizing plant, the proportion of water gas made, whether benzole extraction is practised, and the design and age of the steam-using plant, together with the lay-out of the works.

Taking a series of modernized works, where the ammonia liquor is worked up into sulphate of ammonia in a separate establishment with its own boiler plant, and is therefore not included, the consumption of steam varies as follows:—

Per 1,000 c.ft. of gas	. .	81 to 101 lbs. from and at 212° F.
Per ton of coal carbonized	.	1,220 to 1,930 " " " "

The amount of steam which can be raised by means of waste-heat boilers depends upon the type of carbonizing plant in use. Continuous vertical installations are not usually provided with recuperators, but as the heat losses in these plants are less than with other types where the coke is water-quenched, due to some extent to the coke being discharged at a low temperature, a large proportion of waste heat is available for the production of steam, and it is possible to obtain 1,300 to 1,400 lbs. of steam from and at 212° F. per ton of coal carbonized; the whole steam requirements of the works can thus be supplied from this source. Even in such cases it is desirable to retain fuel-fired boilers under steam to meet emergencies or sudden peak loads. This results in a consumption of about 19 lbs. of breeze fuel per ton of coal carbonized.

Table I. gives the power used on six works equipped with different types of gas-making plant and shows the gross steam requirements for all purposes, including that used for the generation of electricity. The table also shows the electrical power used, the amount of fuel burnt under boilers, and the total cost of steam and electricity used for all purposes.

Costs of Steam and Electrical Power.

The cost of the generation of electricity depends on the quantity of waste-heat steam available and on the size and efficiency of the generating plant. In the twelve works of the Gas Light and Coke Company, the average cost of current generated, not including capital charges, is 0·25d. per unit.

The costs of steam vary owing to local conditions; where a large proportion of the feed water has to be purchased and chemically treated it may have a considerable influence on the total cost. For example, the works dealt with in Table I. produced steam in waste-heat boilers over a period of six months at costs (not including capital charges) varying from 1s. 2d. to 2s. 4d. per unit of 10,000 lbs. from and at 212° F.

Direct Use of Steam.

The author favours the direct use of steam for driving gas pumping and exhausting plant, and for all boiler feed pumps and the draught fans of waste-heat boilers, as such plant should be safeguarded as much as possible from stoppages of even short duration. In addition, the direct use of steam is economical for power purposes when the exhaust can be used for process work.

Exhaust steam is used largely for heating water prior to softening processes, and feed heating. The steaming of vertical retorts and chambers can be conveniently carried out by the exhaust from the waste-heat boiler fan turbines. The steam required for the manufacture of sulphate of ammonia can be obtained from back-pressure turbines used for the generation of electricity. Gas-drying plants can and are being arranged so that the several circulating pumps are driven by steam turbines, the exhaust from which is used in the calcium chloride evaporators.

One of the largest plants in this country for the recovery of benzole is installed at Beckton. This plant uses activated carbon as a medium for the recovery of benzole, and requires considerable quantities of steam at low pressures. It is so arranged that this steam can be obtained from the pass-out and back-pressure turbines which are used to pump the gas through the plant.

The use of exhaust steam has not been adopted for use in water gas plants in this country due to the development of

* From a paper on "Gas-Works Practice" before the Institution of Mechanical Engineers, April 20, 1934.

TABLE I.—*Steam and Electrical Requirements at Several Works of the Gas Light and Coke Company.*

[Per 1,000 c ft. gas, for six months ending June 30, 1933.]

Station.	Type of Plant.	Steam Used. Lbs.	Consumption of Electrical Power. Kw.-Hours.	Waste Heat Steam. %	Fuel under Boilers. Lbs.	Cost of all Power and Process Steam. Pence.†
Works A . .	Horizontal retorts Coke ovens Carburetted water gas plant	101	0·619	55	7·56	0·64
Works B . .	Horizontal retorts Carburetted water gas plant	94	0·276	53	9·29	0·63
Works C . .	Continuous vertical retorts Carburetted water gas plant	98	0·358	94	1·09	0·38
Works D . .	Horizontal retorts Continuous vertical retorts Carburetted water gas plant	90	0·474	84	2·80	0·54
Works E . .	Horizontal retorts Continous vertical retorts Carburetted water gas plant	82	0·466	90	1·39	0·42
Works F* .	Intermittent chambers	81	0·535	39	7·78	0·76

*Only half the carbonizing plant was completed and in action during this period, and the carburetted water gas plant was in course of erection.
† Includes cost of electricity, as well as steam.

the water-jacketed generator which supplies all the steam necessary for this process.

In order to assist in purifying gas it is beneficial to increase its temperature prior to its inlet to the purifiers; exhaust steam can be economically utilized for this purpose. Generally, process steam should be free from oil; turbines are preferable to reciprocating engines in this respect.

VACUUM STEAM ECONOMIZERS.

An apparatus which has recently been introduced into the Industry is the vacuum steam economizer. It is used where large quantities of steam are required at low pressure and only steam at relatively high pressure is available.

The pressure is reduced by passing the steam through the nozzle of an ejector, thereby causing a partial vacuum to be produced in a vessel partly filled with water at high temperature. This combination of vacuum and temperature conditions evaporates the water, which is drawn through the ejector as steam and mixes with the steam issuing from the nozzle. The economizer is provided with heater tubes below the water level, through which steam or other vapours requiring cooling can be passed, so that heat can be transferred to the water in the economizer. By this method, it is possible to produce about 1¾ lbs. of steam at 3 lbs. per sq. in. for every pound of steam at 100 to 150 lbs. per sq. in. passed through the ejector nozzle.

STEAM ACCUMULATORS.

Steam accumulators are now being employed to meet sudden demands of steam for process work, and their use has proved beneficial in conjunction with waste-heat boilers as they minimize or entirely prevent steam being blown to waste during periods of light load.

In many works the various steam-driven units are placed at considerable distances apart, involving correspondingly great lengths of steam mains, and to retain the degree of superheat required by turbine-driven plant it is necessary to arrange for high steam velocities in the pipes. The velocity in the mains is dependent on the load on the steam system, so that the size of the mains is selected to ensure that at light loads the steam reaches the turbines above saturation point.

Birmingham Corporation Gas Order

The Special Order promoted by the Birmingham Corporation under the Gas Undertakings Acts has for its main objects the definition of the existing limits of gas supply (rendered necessary by changes of areas and names of areas, following the county review), and the extension of the limits of supply into areas most of which are at present within the limits of supply of other statutory undertakings, who are willing to transfer them to the Birmingham undertaking by agreement. The Order was the subject of an inquiry by Mr. J. F. Ronca, O.B.E. (the Director of Gas Administration), at the Board of Trade Offices, Westminster, on Friday, April 20.

The proposed extensions of area comprise parts of the City of Birmingham (which are not now within the limits), the County Borough of Smethwick, the Borough of Sutton Coldfield. the Urban Districts of Halesowen, Oldbury, and Solihull, and the Rural Districts of Bromsgrove, Lichfield, Meriden, and Stratford-on-Avon.

The Cannock District Gaslight Company, Ltd., opposed the transfer of Shenstone (a parish in the rural district of Lichfield) from the Lichfield Gas Company's limits to the Birmingham limits; and the Warwickshire, Worcestershire, and Staffordshire County Councils asked for protective clauses relating to highways. A point was also raised by the Solihull Gas Company, who wanted power to lay mains in a part of their area (which is to be transferred to Birmingham) in order to connect other parts of their area which they are retaining. The Corporation agreed to a clause giving this power, so that there was no active opposition by this Company.

Mr. H. WENTWORTH PRITCHARD (of Messrs. Sharpe, Pritchard, & Co., Parliamentary Agents, representing the Birmingham Corporation) said it was significant that there was no opposition from the local authorities in the areas concerned (apart from that of the County Councils, which related to a clause matter), and the Corporation believed that all the local authorities affected would welcome the Corporation giving a supply of gas in their areas.

The Cannock District Gas Company, Ltd., objected to the proposed inclusion of the parish of Shenstone within the Birmingham supply area, and urged that if it were to be transferred, it should go to the Cannock Company instead of to the Birmingham Corporation.

Since 1878, Shenstone had been within the statutory limits of supply of the Lichfield Gas Company, but that Company had never supplied gas there in any large quantity. In 1931 the Cannock Company had applied for an Order to acquire the Ogley Hay and Brownhills Gas Company, and to extend its area of supply into part of the parish of Shenstone, but the Board of Trade had not granted that extension. There was opposition at that time by the Lichfield Gas Company, who had stated that they were intending within reasonable time to take a bulk supply of gas from Walsall, and that if the parish were taken out of the Lichfield Company's area they would be able to obtain a bulk supply from Walsall only at greatly increased cost. However, a small part of the parish of Shenstone was added to the Cannock Company's area, and that part was not included in the present application by Birmingham.

Since 1902 the Birmingham Corporation had supplied gas to some consumers in Shenstone, by agreement with the Lichfield Company, it being more convenient for the Corporation to supply there, the Birmingham mains being nearer than the Company's mains. Particularly since the Cannock application was refused, the Corporation had received applications from other residents for supplies, and the Lichfield Company had concluded that when the time came for taking a bulk supply it would be better to take it from Birmingham than from Walsall. The main feature of the agreement between the Corporation and the Lichfield Company was that the Corporation would lay a trunk main through the parish of Shenstone, and as part of the bargain the Lichfield Company were prepared to give up to the Corporation the right to supply in the part of Shenstone which was now within their area; the Corporation would immediately supply consumers in that area if the Order were passed. That arrangement would be economical and advantageous for both parties. Walsall had been consulted in the matter and were perfectly satisfied with the arrangement.

If the Order were altered so that this part of Shenstone could not be transferred to Birmingham, the agreement entered into with the Lichfield Company would have to be terminated,

because from the financial point of view Birmingham could not possibly give the Company a bulk supply at the proposed price except on the terms of the agreement.

The Cannock Company's Opposition.

The position of the Cannock Company was most extraordinary. In the first place, there was no proposal now before the Board of Trade to transfer the Shenstone area to the Cannock Company. Secondly, as recently as 1931 the Board of Trade had refused to give that area to Cannock. If the Corporation's application were refused, he did not know whether the Cannock Company would then apply for the area, but there was every reason to suppose that if they did that they would meet the same opposition as in 1931 and that the Board of Trade would give the same decision. On the other hand, if the Corporation's application were granted, a supply would be provided in the area straight away.

Then the Cannock Company had suggested that if the whole of the affected part of the parish could not go to them, they wanted part of it. That part, however, was the part containing all the developments, and was the only remunerative part for gas supply.

It was urged by the Cannock Company that it was not in the interests of consumers or potential consumers in the parish that the supply should be obtained from the Corporation, whose works were at least 10 miles away, and that a supply could be afforded by the Company more conveniently and at considerably less capital cost. Mr. Pritchard pointed out, however, that the Corporation could supply just as conveniently and at the same capital cost; it had a boosting plant conveniently situated. The price of the Corporation's gas was very much less than that of the Company, and the Corporation's service was very much better. If the Board of Trade refused the application for the area, no one would benefit; it was very doubtful whether gas would then be supplied in the area for a long time. If the application were granted, it would benefit the inhabitants because they would get a cheap and good supply of gas very soon, and it would benefit the Lichfield Company and the Corporation.

Mr. *A. W. Smith*, F.C.I.S. (General Manager and Secretary of the Birmingham Gas Department), said that the prices of gas charged by the Cannock Company in part of their area of supply ranged from 7d. (for power purposes) to 12·4d. per therm to ordinary consumers, and in the Brownhills district they charged 0·4d. per therm higher. This compared with 4·21d. to 7·79d. per therm, less 5%, in Birmingham's existing scale of charges, which prices it was proposed to charge in the added areas. The Cannock Company, in their 1931 Order, had obtained authority to charge differential prices to the outer parts of their area of supply; one assumed, therefore, that if they supplied in an outer area such as Shenstone they would charge differential prices.

Figures contrasting the quantities of gas made annually by the Birmingham and Cannock undertakings respectively, consumption per consumer, consumption per mile of main, and so on, were given to show that Birmingham was in a better position than the Cannock Company to give a supply; and Mr. Smith made the point that, according to the latest Board of Trade Return, no gas examiner had been appointed to examine the quality and pressure of gas supplied by the Cannock Company; whereas the Birmingham Corporation had appointed its gas examiner, the Worcestershire County Council had appointed an examiner to test the gas supplied to one part of the district, and there were recording calorimeters at all the works.

Mr. *G. S. Russell* (Chairman of the Lichfield Company) was the only other witness. He said that if the Cannock Company had obtained the part of Shenstone which they had asked for in 1931 it would have shut out the Lichfield Company's chance of getting the most direct supply from Walsall, and that if the Cannock Company had the whole of Shenstone it would prevent the Lichfield Company obtaining a supply from Birmingham. If the Cannock Company could have offered a supply on the same terms as Birmingham, with as good a service, it would have been considered.

In cross-examination, he admitted that the Cannock Company could supply in Shenstone at less expenditure than the Lichfield Company could at the moment.

In re-examination, he added that by reason of the bulk supply from Birmingham, his Company could supply its existing consumers more cheaply, and the Shenstone consumers also would get a cheap supply.

Mr. C. J. Jackson (of Messrs. J. M. McDonnell Jackson & Co., Parliamentary Agents, for the Cannock Company), addressing Mr. Ronca, said the area for which the Cannock Company had applied in 1931 lay quite naturally within what would be the probable natural extension of the Company's limits. He suggested that if the present Order were granted there should be a provision to prevent the Birmingham Corporation exercising its powers in that area if the Cannock Company applied for powers over that area within a year from the present time. There seemed no reason, he said, from a general standpoint, why a gas undertaking of the character of the Cannock Company, which should be entitled to expansion, should have that expansion checked by the Corporation of Birmingham, whose

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activities were being rather far extended. No doubt the Birmingham undertaking could supply at a cheaper rate than a small undertaking; but, on the other hand, the Cannock Company having been authorized to carry on their undertaking, they should not be confined in their activities merely because a large undertaker might be able to do something better.

If his suggestion to postpone the exercise of powers by Birmingham could not be accepted, he asked the Board of Trade not to grant the powers sought by the Corporation in the area concerned.

Mr. PRITCHARD said that if the developed part of Shenstone were taken out of the area to be transferred to the Birmingham undertaking, the agreement with the Lichfield Company would have to go, because the Corporation could not then afford to lay the trunk main and there would be no reason for the Corporation having the remainder of Shenstone, which would have no prospect of a supply.

If the Cannock Company wanted to lay mains through that area, in order to connect another part of their area, the Corporation would undertake not to oppose an application for power to do so, provided such mains were not used to supply consumers in the Corporation's area.

PROTECTIVE CLAUSES.

Dealing with the protective clauses sought by the County Councils in regard to county bridges and roads, he said that the Corporation strongly objected to the details of those clauses; but apart from that, he asked the Board of Trade to deal with the matter as one of principle. The present Order incorporated the Gas-Works (Clauses) Acts, which covered the problem, and which had applied also for many years over the very large area supplied by the Corporation. No onerous provisions such as were now asked for had been imposed, but there had been no difficulty in the working of the provisions of the Clauses Acts. The areas now proposed to be taken over by the Corporation were mostly within the areas of other statutory gas undertakers at the moment, and it was most unfair that the County Councils should pick upon the adjustment of areas now proposed, to the benefit of consumers, as an opportunity for imposing onerous conditions which did not now apply to the Birmingham undertaking or to the other undertakings which had agreed to those adjustments. Further, the clauses were aimed, not only at the areas proposed to be added to the Corporation's limits of supply, but also to its existing limits—a most unheard-of proposal.

Mr. J. A. TURNER (Deputy Clerk, Warwickshire County Council) said he would withdraw the application of the proposed clauses to the Corporation's existing limits, and would ask that they be applied to the areas to be added by this Order.

Mr. PRITCHARD said the proposed extensions were asked for mainly at the request of inhabitants. The Corporation did not propose to charge higher prices in the added areas, and he understood that the policy of Parliament was opposed to differential charges.

Mr. RONCA said he did not think that the power to charge differential prices had been refused in cases where it was justified.

Mr. PRITCHARD replied that in any case the Corporation proposed to charge the same prices throughout the whole of its area of supply. On the other hand, it had to provide mains, and it could not possibly be expected to supply gas at the same price to the outlying areas as to the inner areas if it were to be subjected to the onerous conditions asked for by the County Councils. There were no special circumstances in this case.

Mr. TURNER (speaking for the County Councils) urged that the Gas-Works (Clauses) Act of 1847 did not afford sufficient protection under present-day conditions for County Councils in their position as highway authorities. In 1847, traffic conditions as understood to-day were practically non-existent, and owing to the enormous increase in vehicular traffic County Councils were desirous of carrying out reconstruction and widening of roads and bridges. Delays might arise unless there were protective provisions whereby matters relating to alterations of the positions of mains, and so on, were placed on a definite footing. The relevant sections of the 1847 Act were indefinite and incomplete.

Mr. R. STACEY (Chief Assistant to the Clerk of the Staffordshire County Council) emphasized the obligations of the County Councils in connection with widenings, particularly of bridges, to render them suitable for modern traffic. Over most of these bridges, he said, gas and other mains were laid, and generally there were no special provisions in Gas Acts providing for the gas undertakers taking some responsibility for altering the position of the mains when widening work was being carried out; and the County Councils had had no voice in connection with the laying of the mains in many cases. The ratepayers had to bear a great proportion of the costs of widenings, and it was considered unfair that the Corporation Gas Department should be relieved from responsibility in connection with the laying of mains in roads or over bridges which probably had to be widened or reconstructed in the near future. The Cannock Gas Company were subject to a clause on practically the same lines as those now asked for, and there was a special protective clause applying to the Burton-on-Trent Corporation.

Subsequent discussion disclosed that the clauses inserted in these cases were the result of agreements between the parties, and Mr. Pritchard emphasized that there was no precedent for their insertion in any disputed case.

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Thickness	0·25 ins.
Length (effective)	4 yards
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The external diameter of the pipe and the internal diameter of the socket are to British Standard Specification. The increased bore gives an effective carrying capacity approximately 20% greater than that of an ordinary 3-inch diameter Cast Iron Pipe or Steel Tube.

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GAS MARKETS & MANUFACTURES

Stock Market Report.

[For Stock and Share List, see later page.]

The City was well pleased with the Budget, but, as is usually the case at these times, the "boom" which set in on the Stock Exchange during the anticipatory period came to an abrupt end when the Chancellor's proposals became known. A large profit-taking movement was in evidence and prices fell, but it is anticipated that the reaction will be short-lived in view of the general undertone of confidence. The benefits bestowed by the Budget lie in the future, and should prove an important factor in the furtherance of the present trade recovery.

Gas stocks and shares remained unaffected by the general conditions, and the number of recorded transactions was about normal. Prices continued very firm with few changes. Gas Light units were in good demand, and the quotation advanced 4½d. to 26s. 7½d., business being done at 26s. 10½d. The margin of Bournemouth sliding-scale stock shortened from 10 to 5 points at 205½, leaving a net gain of 3½, while South Metropolitan and South Suburban ordinaries both hardened 1, the margin of the latter stock narrowing from 5 to 3 points.

Details have now been published of the latest holding company, the South Midland Gas Corporation, Ltd. The Corporation has purchased, or agreed to purchase, 88% of the issued ordinary capital of the Witney Gas and Coke Company, Ltd., 80% of the issued ordinary capital of the Banbury Gas Light and Coke Company, and the Eynsham Station of the British Gas Light Company. The authorized capital is £75,000, half of which will be redeemable 4½% cumulative preference shares of £1 each and the other half £1 ordinary shares. It is proposed to issue £28,371 preference shares and £28,500 ordinary shares, a total of £56,871. The preference shares will be redeemable after March, 1974, and before March, 1984, at a premium of 2½%, *plus* accrued interest. On the basis of the past three years the estimated revenue from the two companies *plus* the profits from the Eynsham Station, after meeting the preference dividend, are equivalent to over 6% on the issued ordinary capital.

The Directors of the South Eastern Gas Corporation, the concern controlled by the Gas Light and Coke Company, have declared a final dividend on the ordinary shares of 3%, making a total of 6% for the year. This completes the first year of the Corporation's activities.

Current Sales of Gas Products.

The London Market for Tar Products.

LONDON, *April* 23.

The tar products market continues steady with current prices as follows:

Pitch, 57s. 6d. per ton f.o.b.

Creosote, 3¼d. to 3½d. per gallon.

Refined tar, 4d. to 4¼d. per gallon in bulk at makers' works.

Pure toluole, 2s. 7d. to 2s. 8d.; pure benzole, 1s. 9d. to 1s. 10d.; 95/160 solvent naphtha, 1s. 8d. to 1s. 9d.; and 90/140 pyridine bases, about 6s.—all per gallon naked at makers' works.

Tar Products in the Provinces.

April 24.

The average prices of gas-works products during the week were: Gas-works tar, 23s. to 28s. Pitch—East Coast, 56s. 3d. to 58s. 9d. f.o.b. West Coast—Manchester, Liverpool, Clyde, 56s. 3d. to 58s. 9d.* Toluole, naked, North, 2s. 1d. to 2s. 3d. Coal-tar crude naphtha, in bulk, North, 6½d. to 6¾d. Solvent naphtha, naked, North, 1s. 5d. to 1s. 6d. Heavy naphtha, North, 10d. to 11d. Creosote, *ex* works, in bulk, North, liquid, and salty, 2⅝d. to 2⅞d.; low gravity, 2¼d. to 2⅜d.; Scotland, 2½d. to 2¾d. Heavy oils, in bulk, North, 3¾d. to 4¼d. Carbolic acid, 60's, 2s. 2d. to 2s. 3d. Naphthalene, £10 to £11. Salts, 55s. to 75s., bags included. Anthracene, "A" quality, 2½d. to 3d. per minimum 40%, purely nominal; "B" quality, unsalable.

* All prices for pitch are now quoted on the basis of f.o.b. In order to arrive at the f.a.s. value at any port it will be necessary to deduct the loading costs and the tolls whatever they may be.

Tar Products in Scotland.

GLASGOW, *April* 21.

Distillers being well sold in many departments for prompt delivery, new business is difficult to arrange.

Crude gas-works tar.—The actual value is 35s. to 37s. per ton *ex* works.

Pitch.—There is little or no business being offered, and values are purely nominal at about 47s. 6d. to 50s. per ton f.o.b. Glasgow for export, and round 45s. to 47s. 6d. per ton *ex* works in bulk for home trade.

Refined tar.—Makers are maintaining quotations at 3d. per gallon *ex* works in bulk, but competition is very keen, and it is possible this figure will be broken within the next few weeks.

Creosote oil.—Prompt supplies remain difficult to secure, and prices are, therefore, steady. B.E.S.A. specification oil is 4d. to 4¼d. per gallon; low gravity, 4d. to 4¼d. per gallon; and neutral oil, 4d. to 4¼d. per gallon—all in bulk *ex* works.

Cresylic acid.—Little new business is being arranged, but prices remain firm. Pale, 97/99%, is 1s. 2d. to 1s. 3d. per gallon; dark, 97/99%, 11½d. to 1s. per gallon; and pale, 99/100%, 1s. 4d. to 1s. 5d. per gallon—all f.o.r. in buyers' packages.

Crude naphtha is still valued at 4¾d. to 5¼d. per gallon, according to quality and quantity, with production small.

Solvent naphtha.—90/160 grade is 1s. 4d. to 1s. 4½d. per gallon, and 90/190 grade is 8d. to 8½d. per gallon.

Motor benzole.—This is valued at 1s. 6d. to 1s. 7d. per gallon, but supplies are difficult to secure.

Pyridines.—90/160 grade is 5s. to 5s. 3d. per gallon, and 90/140 grade is 5s. 6d. to 6s. per gallon.

Benzole Prices.

These are considered to be the market prices for benzole at the present time:

	s.	d.		s.	d.	
Crude benzole	0	9	to	0	9½	per gallon at works
Motor ,,	1	4	,,	1	4½	,, ,, ,,
90% ,,	1	4½	,,	1	5	,, ,, ,,
Pure ,,	1	7½	,,	1	8	,, ,, ,,

Contracts Advertised To-Day.

Coal.

Rhyl Gas Department. [p. 217.]

Meters.

Stockton-on-Tees Gas Department. [p. 217.]

Oxide of Iron.

Cowes Gas Department. [p. 217.]

Stores.

Stockton-on-Tees Gas Department. [p. 217.]

New Capital Issues.

Weymouth Consumers' Gas Company.—The tenders sent in for the £35,000 4% perpetual debenture stock, which Messrs. A. & W. Richards offered on behalf of the Directors of this Company, were opened on April 19. They amounted to a total of £160,675 at prices ranging from £110 10s. per £100 down to the minimum of par. The lowest accepted tender was at £103 6s., and the average price obtained £104 4s.%.

Trade Notes.

British Diesel Engines.

Messrs. Crossley Brothers, Ltd., Manchester, and their associated Company, the Premier Gas Engine Company, Ltd., Nottingham, have received during the past month orders that exceed 11,000 B.H.P. and come from almost every corner of the world. Included among these is one from the Burmah Oil Company, Ltd., for nine Crossley vertical diesel engines with Mather & Platt pumps, each capable of dealing with 630,000 gallons of crude oil a day.

Special Order Applications.

Brighton, Hove, and Worthing Gas Company.

Application is being made by the Company to the Board of Trade for a Special Order to provide for the transfer to them of the undertaking of the Littlehampton Gas Company.

Wandsworth and District Gas Company.

Application is being made by the Company for a Special Order to authorize them to raise additional capital, and to borrow more money.

STOCK AND SHARE LIST.

Official Quotations on the London and Provincial Stock Exchanges.

Issue. £	Share.	When ex-Dividend.	Dividends. Prev. Hf.-Yr. % p.a.	Dividends. Last Hf.-Yr. % p.a.	NAME.	Quotations. April 21. (Provincial Exchanges April 20.)	Rise or Fall on Week.	Transactions. Lowest and Highest Prices During the Week.
1,551,868	Stk.	Apl. 9	7	7	Alliance & Dublin Ord. ...	128–138*	...	134
374,000	,,	Jan. 8	4	4	Do. 4 p.c. Deb. ...	90–100	...	...
557,655	,,	Mar. 5	7	7	Barnet Ord. 7 p.c.	165–170	...	168½–171
300,000	1	Oct. 23	1/9⅓	1/4⅔	Bombay, Ltd	27/–29/-	...	27/9–28/3
178,480	Stk.	Feb. 19	9½	9½	Bournemouth sliding scale	203–208	+3½	...
550,050	,,	,,	7	7	Do. 7 p.c. max. ...	162–167	...	165
439,160	,,	,,	6	6	Do. 6 p.c. Pref ...	142–147	...	...
50,000	,,	Dec. 18	3	3	Do. 3 p.c. Deb. ...	79–84	...	...
262,025	,,	,,	4	4	Do. 4 p.c. Deb. ...	103–107	+1½	104½–106
335,000	,,	,,	5	5	Do. 5 p.c. Deb. ...	120–125	...	...
357,900	,,	Mar. 5	7½	7½	Brighton, &c , 6 p.c. Con. ...	161–166	...	162
540,000	,,	,,	6¾	6¾	Do. 5 p.c. Con. ...	149–154	...	...
195,500	,,	,,	6	6	Do. 6 p.c. B. Pref.	135–140	...	...
1,487,500	,,	Mar. 5	5	5	Bristol 5 p.c. max.	114½–115½*a*	...	...
120,420	,,	Dec. 18	4	4	Do. 1st 4 p.c. Deb. ...	101–103*a*	...	...
217,870	,,	,,	4	4	Do. 2nd 4 p.c. Deb. ...	101–103*a*	...	...
328,790	,,	,,	5	5	Do. 5 p.c. Deb.	123–125*a*	...	...
885,000	,,	Apl. 9	7	8	British Ord.	153–158*	...	154
100,000	,,	Dec. 18	7	7	Do. 7 p.c. Pref.	153–158	...	...
350,000	,,	,,	5½	5½	Do. 5½ p.c. Pref.	106–111	...	...
120,000	,,	,,	4	4	Do. 4 p.c. Red. Deb. ...	95–100	...	...
450,000	,,	,,	5	5	Do. 5 p.c. Red. Deb. ...	107–112	...	...
160,000	,,	Jan. 8	5	5	Cambridge 5 p.c. Deb. ...	115–120	...	...
100,000	10	May 22	8	4	Cape Town, Ltd.	4½–5½	...	...
100,000	10	Nov. 6	4½	4½	Do. 4½ p.c. Pref. ...	6¾–7¾	...	...
150,000	Stk.	Dec. 18	4½	4½	Do. 4½ p.c. Deb. ...	95–100	...	...
626,860	,,	Feb. 19	6	6	Cardiff Con. Ord.	126–131	...	...
237,860	,,	Jan. 8	5	5	Do. 5 p.c. Red. Deb.	103–108	...	...
157,150	,,	Feb. 19	5	6½	Chester 5 p.c. Ord.	112½–122½*b*	...	...
98,936	1	Oct. 9	2/-	2/-	Colombo, Ltd. Ord.	1⅞–1⅞	...	...
24,500	1	,,	1/4½	1/4½	Do. 7 p.c. Pref. ...	19/- 21/-	...	...
609,204	1	Mar. 19	/11'48	/11'48	Colonial Gas Assn. Ltd. Ord.	1⅞–1⅞	...	20/6–21/-
296,053	1	,,	1/8'30	1/8'30	Do. 8 p.c. Pref.	22/6–24/6	...	24/-
1,775,005	Stk.	Feb. 19	5	6½	Commercial Ord.	120–125	...	120⅝–121½
475,000	,,	Dec. 18	3	3	Do. 3 p.c. Deb. ...	77–82	...	...
286,344	,,	Mar. 5	5	5	Do. 5 p.c. Deb. ...	119–124	...	...
807,560	,,	Feb. 19	7	7	Croydon sliding scale ...	153–158	...	156–157
569,590	,,	,,	5	5	Do. max. div.	105–110	...	108½
620,385	,,	Jan. 8	5	5	Do. 5 p.c. Deb.... ...	121–126	...	...
542,270	,,	Mar. 5	7	10	Derby Con.	175–180*c*	...	...
55,000	,,	Jan. 8	4	4	Do. 4 p.c. Deb. ...	98–100*c*	...	...
209,000	,,	Feb. 19	5	5	East Hull Ord. 5 p.c. ...	106–111	...	...
181,625	,,	Mar. 5	6	6	East Surrey Ord. 5 p.c. ...	126–131	...	...
175,609	,,	Dec. 18	5	5	Do. 5 p.c. Deb. ...	118–123	...	121½–122
1,002,180	,,	Apl. 9	†5	†7	European, Ltd.	120–130*	...	120–123
19,342,763	,,	Feb. 19	5⅔	5⅔	Gas Light & Coke 4 p.c. Ord.	26/4½ – 26/10½*f*	+/4½	26/2½–26/10½
2,600,000	,,	,,	3½	3½	Do. 3½ p.c. max. ...	87–90	...	88–89
4,477,106	,,	,,	4	4	Do. 4 p.c. Con. Pref. ...	103–106	...	104½–105⅔
6,102,497	,,	Dec. 18	3	3	Do. 3 p.c. Con. Deb. ...	84–87	...	85½–86½
3,643,770	,,	,,	5	5	Do. 5 p.c. Red. Deb. ...	116–119	...	117⅔–118½
3,500,000	,,	,,	4½	4½	Do. 4½ p.c. Red. Deb. ...	114–117	+1	115–116
270,466	,,	Mar. 5	6	6	Harrogate New Cons. ...	125–130	...	...
82,500	,,	Mar. 5	7	7	Hastings & St. L. 5 p.c. Conv.	147–152	...	150
258,740	,,	,,	5½	5½	Do. 3½ p.c. Conv.	115–120	...	118–119
140,000	1	Oct. 9	†10	1/7½	Hongkong & China, Ltd. ...	29/–32/-	...	29/–30/9
218,200	Stk.	Mar. 5	6	6	Hornsey Con. 3½ p.c. ...	128–133	...	...
5,600,000	,,	Nov. 6	†4	10	Imperial Continental Cap.	203–208	...	204–206
223,130	,,	Feb. 5	3½	3½	Do. 3½ p.c. Red. Deb.	89–94	...	...
235,242	,,	Mar. 5	8½	8½	Lea Bridge 5 p.c. Ord. ...	169–174	...	...
2,167,410	,,	Mar. 5	6	6	Liverpool 5 p.c. Ord. ...	130–132*b*	...	...
245,500	,,	Dec. 18	5	5	Do 5 p.c. Red. Pref. ...	101–111*b*	...	...
306,083	,,	July 17	4	4	Do. 4 p.c. Deb. ...	101½–103½*b*	...	...
165,786	,,	Feb 19	8	10	Maidstone 5 p.c. Cap. ...	180–190	...	...
56,176	,,	Jan. 8	3	3	Do. 3 p.c. Deb. ...	72–77	...	...
75,000	5	Dec. 4	†10	†10	Malta & Mediterranean ...	9–11	...	...
392,000	—	Apl 3	5½	5½	Metropolitan (of Melbourne) 5½ p.c. Red. Deb.	96–101	...	...
231,978	Stk.	Feb. 19	5	5	M. S. Utility "C." Cons. ...	113–118	...	...
818,657	,,	,,	4	4	Do. 4 p.c. Cons. Pref.	95–100	...	...
360,075	,,	Jan. 8	4	4	Do. 4 p.c. Deb. ...	100–105	...	...
148,955	,,	,,	5	†5	Do. 5 p.c. Deb. ...	117–122	...	...
675,000	,,	31 May '31	†6	6	Montevideo, Ltd.	60–70	...	62–64
2,061,315	,,	Mar. 5	5	5⅔	Newcastle & Gateshead Con.	25/–25/9*d*	...	...
682,856	,,	,,	4	4	Do. 4 p.c. Pref. ...	99–101*d*	...	...
776,706	,,	Jan. 8	3½	3½	Do. 3½ p.c. Deb. ...	92–93*d*	...	...
277,285	,,	Nov. 6	5	5	Do. 5 p.c. Deb. '43 ...	105–107*d*	...	...
274,000	,,	Feb. 19	5	5	Newport (Mon.) 5 p.c. max.	106–108*a*	...	...
204,940	,,	Mar. 19	7½	7½	North Middlesex 6 p.c. Con.	155–160	...	...
393,160	,,	Feb. 5	5	5	Northampton 5 p.c. max. ...	99–104	...	...
300,000	,,	Dec. 4	7	†9	Oriental, Ltd.	147–152	...	150
316,617	,,	Dec. 18	8	8	Plym'th & Stonehouse 5 p.c.	165–170	...	...
504,416	,,	Feb. 19	8	8	Portsm'th Con. Stk. 4 p.c. Std	168–173	...	171
241,446	,,	,,	5	5	Do. 5 p.c. max. ...	105–110	...	...
114,000	,,	Feb. 19	5	5	Preston 5 p.c. Pref.	103–108	...	...
686,312	,,	Jan. 22	4	4	Primitiva 4 p.c. Rd. Db. 1911	87–92	...	...
389,813	,,	Dec. 18	4	4	Do. 4 p.c. Cons. Deb.	88–93	...	...
150,000	10	Mar. 19	6	6	San Paulo 6 p.c. Pref. ...	7–8	...	...
1,736,968	Stk.	Mar. 19	6	6	Sheffield Cons	134–136*	−1	...
95,000	,,	Jan. 8	4	4	Do. 4 p.c. Deb.	94–98*e*	...	...
133,201	,,	Feb. 19	8½	5	Shrewsbury 5 p.c. Ord. ...	135–140	...	...
90,000	10	June 12	15	14	South African	3–5	...	...
6,709,895	Stk.	Feb. 19	5	7	South Met. Ord.	131–134	+1	130½–133
1,135,812	,,	,,	6	6	Do. 6 p.c. Irred. Pf.	138–143	...	142–143½
850,000	,,	,,	4	4	Do. 4 p.c. Irred. Pf.	102–106	...	104½
1,895,445	,,	Jan. 8	3	3	Do. 3 p.c. Deb ...	84–87	...	85½
1 000,000	,,	Jan. 22	5	5	Do. 5 p.c. Red. Deb.	114–117	...	114½
209,820	,,	Mar. 5	8½	8½	South Shields Con.	166–167*d*	...	...
1,543,795	,,	Feb. 19	6	6	South Suburban Ord. 5 p.c.	130–133	+1	131½–133
512,825	,,	,,	5	5	Do. 5 p.c. Pref.	115–120	...	119½
300,000	,,	,,	—	4	Do. 4 p.c. Pref.	103–108	...	106
868,837	,,	Dec. 18	5	5	Do. 5 p.c. Deb.	120–125	...	123–123½
100,000	,,	,,	4	4	Do. 4 p.c. Deb.	103–108	...	...
647,740	,,	Mar 5	5	5	Southampt'n Ord. 5 p.c. max.	109–114	...	...
121,275	,,	Dec. 18	4	4	Do. 4 p.c. Deb.	100–105	...	...
350,000	,,	Mar. 5	5½	5½	Swansea 5½ p.c. Red. Pref.	106–111	...	109
200,000	,,	Dec. 18	6½	6½	Do. 6½ p.c. Red. Deb.	103–108	...	...
1,076,490	,,	Mar. 5	6½	6½	Tottenham and District Ord.	148–153	...	151–153
409,835	,,	,,	5½	5½	Do. 5½ p.c. Pref. ...	123–128	...	...
62,235	,,	,,	5	5	Do. 5 p.c. Pref. ...	112–117	...	113
199,005	,,	Dec. 18	4	4	Do. 4 p.c. Deb. ...	97–102	...	...
85,701	,,	Apl. 9	6	6	Tuscan, Ltd. 6 p.c. Red. Db.	90–100*	...	...
349,110	,,	Mar. 5	7	7	Uxbridge, &c., 5 p.c. ...	150–155	...	154½
88,330	,,	,,	5	5	Do. 5 p.c. Pref. ...	112–117	...	...
1,322,220	,,	Mar. 5	7	7	Wandsworth Consolidated	155–160	...	156–159
1,096,373	,,	,,	5	5	Do. 5 p.c. Pref.	118–123	...	122
1,317,964	,,	Dec. 18	5	5	Do. 5 p.c. Deb.	120–125	...	...
158,400	,,	Mar. 5	5	6*g*	Winchester W. & G. 5 p.c. Con.	115–120	...	...

Quotations at:—*a.*—Bristol. *b.*—Liverpool. *c.*—Nottingham. *d.*—Newcastle. *e.*—Sheffield. *f*—The quotation is per £1 of stock *g.*—Paid £3, including 10s. on account of back dividends. * Ex. div. † Paid free of income-tax. ‡ For year. Hongkong & China, Ltd.—Paid on £10 shares.

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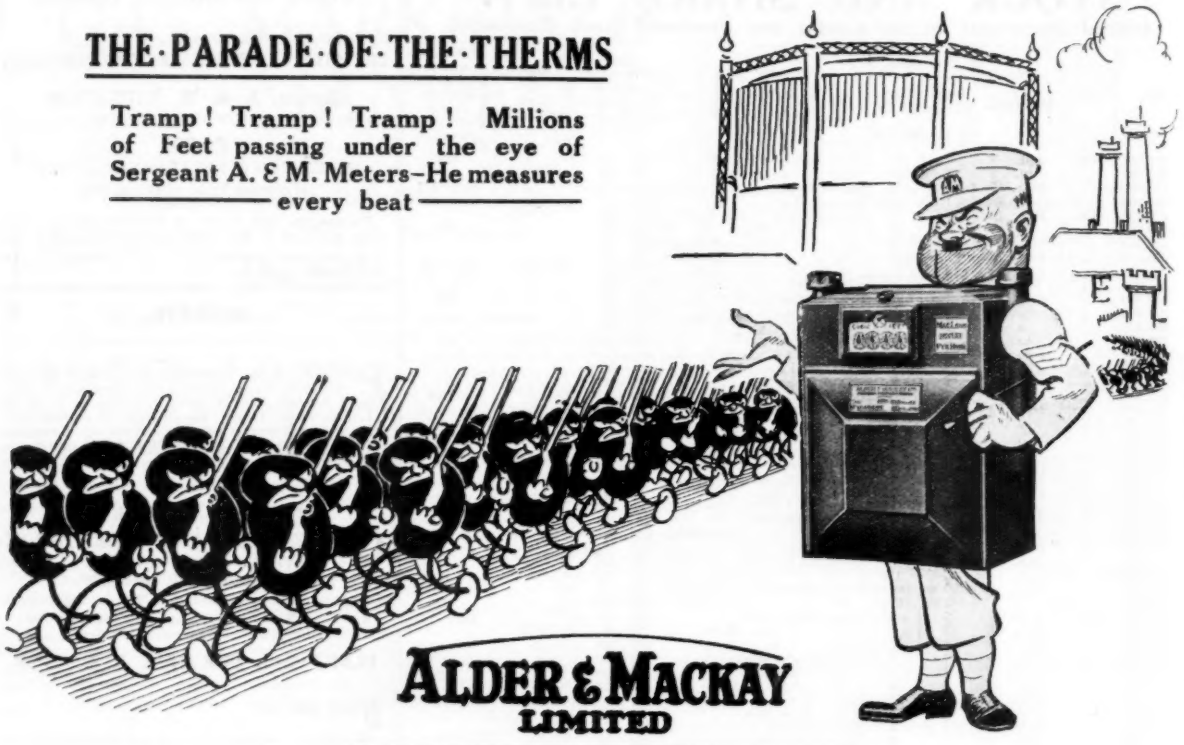

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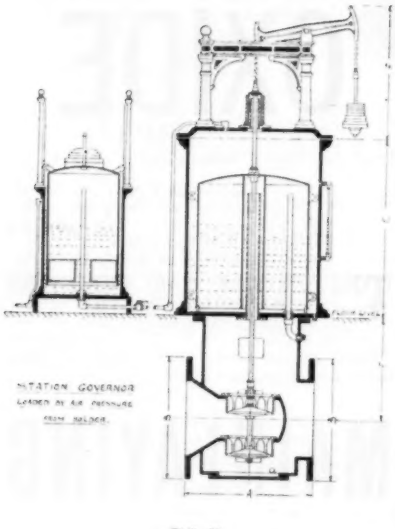

FIG. 22

Peebles

PRESSURE LOADED STATION & DISTRICT GOVERNORS

Where Peebles' Pressure Loaded Station and District Gas Governors score over many other governors is in the ease with which the loading can be changed.

With some patterns, weights up to cwts. and more have to be handled when supply pressures are high, or water to equivalent weight is required, but with Peebles' Pressure Loaded Governors the loading is controlled by a small pilot governor and the gas is returned, the loading weights of which weigh only a few ounces. This pilot can be placed in any convenient position, attached to or near the governor, or loading may be from a small air bell situated anywhere, *e.g.*, in Engineer's office. Alteration, therefore, in the loading can be effected more quickly, and without effort. It is to refinements of design like this that Peebles' Station and District Gas Governors owe their supremacy.

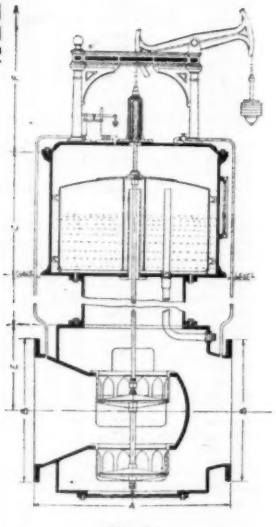

FIG. 29

Early delivery given for all sizes.

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Jay Works
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Write for our Governor Catalogue.